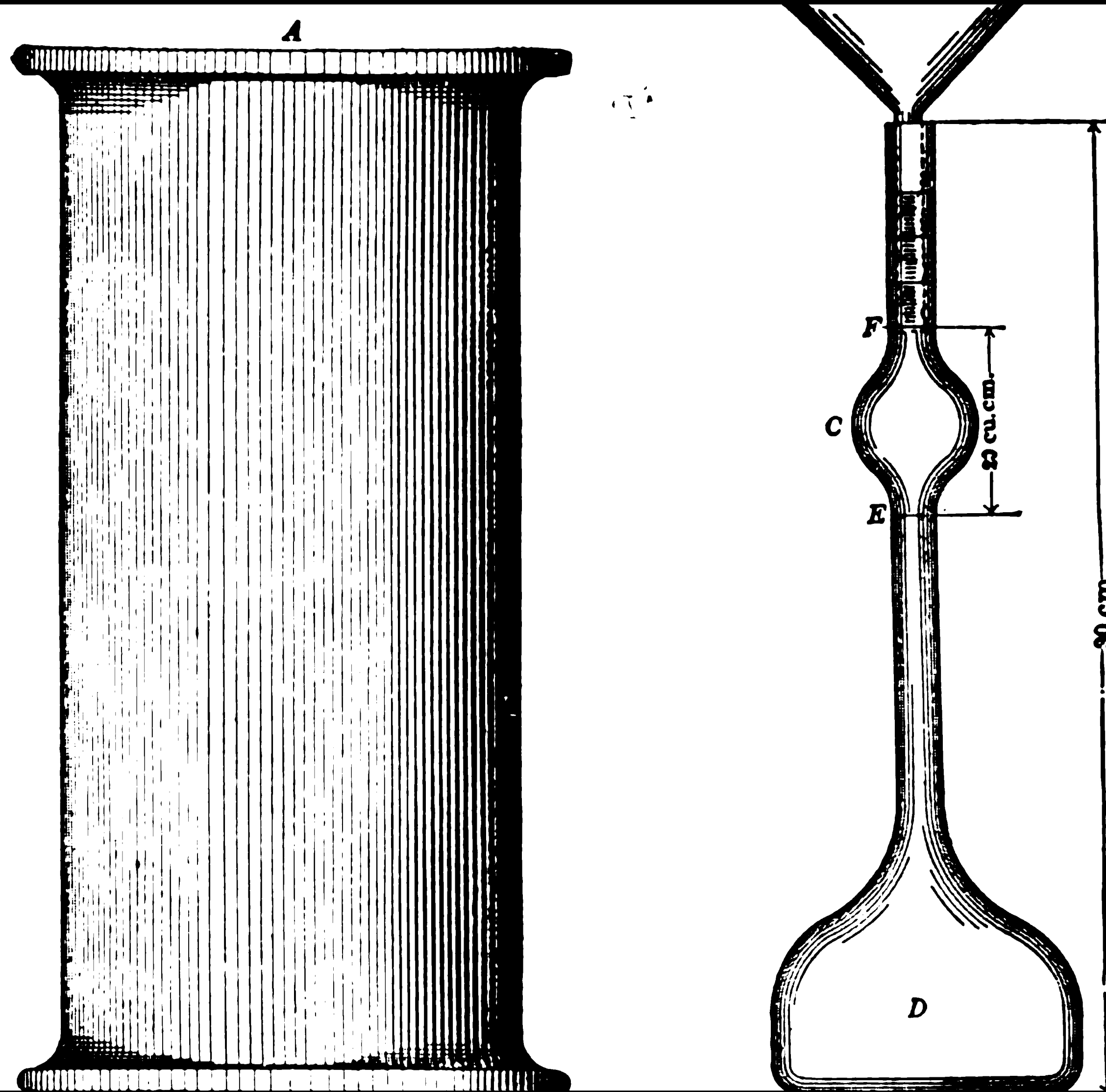


# Year-book

American Society for Testing Materials,
International Association for Testing Materials

# AMERICAN SOCIETY
FOR
# TESTING MATERIALS.

AFFILIATED WITH THE
INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.

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# YEAR-BOOK
# 1910

Containing the Standard Specifications adopted by the Society, List of Members and Technical Committees, and other information concerning the American Society for Testing Materials and the International Association for Testing Materials.

EDITED BY THE SECRETARY, UNDER THE DIRECTION OF THE COMMITTEE ON PUBLICATIONS.

OFFICE OF THE SECRETARY, UNIVERSITY OF PENNSYLVANIA, PHILADELPHIA, PA.
PUBLISHED BY THE SOCIETY.
1910.

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# CHARTER

OF THE

# AMERICAN SOCIETY FOR TESTING MATERIALS.

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*To the Honorable the Judges of the Court of Common Pleas No. 2 in and for the City and County of Philadelphia: of March Term,* 1902, *No.* 2056:

In compliance with the requirements of an Act of the General Assembly of the Commonwealth of Pennsylvania, entitled "An Act to Provide for the Incorporation and Regulation of Certain Corporations," approved the 29th day of April, A.D. one thousand eight hundred and seventy-four, and the supplements thereto, the undersigned, Henry M. Howe, Charles B. Dudley, Edgar Marburg, Robert W. Lesley, Mansfield Merriman, Albert Ladd Colby and William R. Webster, six of whom are citizens of Pennsylvania, having associated themselves together for the purposes hereinafter set forth, and desiring that they may be incorporated according to law, do hereby certify:

1. The name of the proposed corporation is the "AMERICAN SOCIETY FOR TESTING MATERIALS."

2. The corporation is formed for the Promotion of Knowledge of the Materials of Engineering, and the Standardization of Specifications and the Methods of Testing.

3. The business of the said corporation is to be transacted in Philadelphia.

4. The said corporation is to exist perpetually.

5. The names and residences of the incorporators are as follows:

HENRY M. HOWE, 27 West Seventy-third Street, New York.
CHARLES B. DUDLEY, Altoona, Pa.
EDGAR MARBURG, 517 South Forty-first Street, Philadelphia.
ROBERT W. LESLEY, 22 South Fifteenth Street, Philadelphia.
MANSFIELD MERRIMAN, South Bethlehem, Pa.
ALBERT LADD COLBY, South Bethlehem, Pa.
WILLIAM R. WEBSTER, "The Bartram," Thirty-third and Chestnut Streets, Philadelphia.

6. The management of the said corporation shall be vested in an Executive Committee, consisting of six (6) members, viz.: the Chairman, the Vice-Chairman, the Secretary, the Treasurer and two other members of the corporation, and such other officers as the corporation may from time to time appoint.

7. The corporation has no capital stock, and the members thereof shall be composed of the subscribers and their associates and of such persons as may from time to time be admitted by vote in such manner and upon such requirements as may be prescribed by the By-Laws. The corporation shall nevertheless have power to exclude, expel or suspend members for just or legal cause, and in such legal manner as may be ordained and directed by the By-Laws.

8. The By-Laws of this corporation shall be admitted and taken to be its laws subordinate to the statute aforesaid; this Charter; Constitution and Laws of the Commonwealth of Pennsylvania, and the Constitution of the United States; they shall be altered and amended as provided for by the By-Laws themselves; and shall prescribe the powers and functions of the Executive Committee herein mentioned and those to be hereafter elected, the times and places of meetings of the Committee and this corporation; the number of members who shall constitute a quorum at the meetings of the corporation, and of the Committee; the qualifications and manner of electing members; the manner of electing officers; and the powers and duties of such officers; and all other concerns and internal arrangements of the said corporation.

Witness our hands and seals this twenty-first day of March, A.D. 1902.

(Signed)
EDGAR MARBURG,
R. W. LESLEY,
WM. R. WEBSTER,
MANSFIELD MERRIMAN,
ALBERT LADD COLBY.

# BY-LAWS

## ARTICLE I.

### MEMBERS.

SECTION 1. The Society shall consist of Members and Junior Members.

SEC. 2. A Member shall be a person not less than thirty years of age, corporation, firm, technical society, teaching faculty or library, proposed by two members and approved by the Executive Committee.

SEC. 3. A Junior Member shall be a person less than thirty years of age on the date of his admission, proposed by two members and approved by the Executive Committee. A Junior Member shall have the same rights and privileges as a Member, and his status shall be changed from that of Junior Member to Member at the beginning of the fiscal year next succeeding the date on which he attains the age of thirty years.

SEC. 4. Applications for membership and resignation from membership must be transmitted in writing to the Secretary.

## ARTICLE II.

### OFFICERS AND THEIR ELECTION.

SECTION 1. The officers shall be a President, Vice-President, Secretary and Treasurer.

SEC. 2. The offices of Secretary and Treasurer shall be held by the same person.

SEC. 3. These officers shall be elected by letter ballot, at the Annual Meeting, and shall hold office for two years.

SEC. 4. The Executive Committee shall consist of these officers and also the last Past President and seven members, four being elected by letter ballot at each Annual Meeting in the odd years and three at each Annual Meeting in the even years. Four members of the Executive Committee shall constitute a quorum.

SEC. 5. The President shall be, *ex officio*, the nominee for American Member of the Council of the International Association.

SEC. 6. The Secretary shall receive a salary to be fixed by the Executive Committee.

SEC. 7. The officers and members of the Executive Committee shall serve for the respective terms to which they shall have been elected, or until their successors shall have been duly elected.

SEC. 8. The Executive Committee shall have the power to fill any vacancies occurring in their number by death, resignation or otherwise.

SEC. 9. The election of officers and members of the Executive Committee shall be by letter ballot. The Executive Committee, before each Annual Meeting, shall appoint a Nominating Committee, whose duty it shall be to nominate a full list of officers. The list of nominations so made shall be submitted to the membership not more than eight (8) nor less than four (4) weeks before the coming Annual Meeting.

Further nominations, signed by at least ten (10) members, may be submitted to the Secretary in writing at least four (4) weeks before the Annual Meeting, and such nominations shall also be submitted to the membership on the official ballot.

## ARTICLE III.

### MEETINGS.

SECTION 1. The Society shall meet annually. The time and place of each meeting shall be fixed by the Executive Committee.

SEC. 2. Special meetings may be called whenever the Executive Committee shall deem it necessary, or upon the request in writing to the President of twenty-five (25) members.

## ARTICLE IV.

### PROCEDURE GOVERNING THE ADOPTION OF STANDARD SPECIFICATIONS.

SECTION 1. A proposed standard specification must be presented at the Annual Meeting, at which it may be amended by majority vote of those voting. A two-thirds affirmative vote of those voting shall be required to refer the specification to letter ballot of the Society. A two-thirds affirmative vote of those voting on letter ballot shall be required for the adoption of the specification.

## ARTICLE V.

### DUES.

SECTION 1. The fiscal year shall commence in 1910 on the first of August and the dues from August 1, 1910, to December 31, 1910, shall be $5.00 for Members and $2.50 for Junior Members.

SEC. 2. The fiscal year after December 31, 1910, shall begin on the first of January and the annual dues from and after January 1, 1911, shall be $10.00 for Members and $5.00 for Junior Members, payable in advance.

SEC. 3. Members or Junior Members holding membership also in the International Association for Testing Materials shall pay annually, in advance, the additional sum of $2.00, the fiscal year of the International Association beginning on the first of January, which sum shall be transmitted by the Treasurer to the International Association.

SEC. 4. Any Member or Junior Member may compound his dues at the beginning of any fiscal year by the purchase of a life membership, exempting him for life from annual dues, by the payment of the sum of one hundred and fifty dollars ($150); provided such membership is held by an individual. The cost of life membership, or membership in perpetuity, to corporations, firms, technical societies, teaching faculties or libraries shall be two hundred dollars ($200).

SEC. 5. Any member of the Society whose dues shall remain unpaid for a period of three months from the beginning of the fiscal year shall receive a "Second Notice" from the Treasurer; if his dues shall remain unpaid for a period of five months from the beginning of the fiscal year, he shall forfeit the right to vote and to receive the publications of the Society. A month before the close of the fiscal year, he shall receive a final notice from the Treasurer that, if he neglects to pay his dues before the end of the fiscal year, his name may be stricken from the roll of membership by the Executive Committee.

SEC. 6. Any person elected after six months of any fiscal year shall have expired, shall pay only one-half of the amount of dues for that fiscal year; but he shall not be entitled to a copy of the Proceedings of the previous Annual Meeting.

SEC. 7. The resignation of a member whose dues for the current fiscal year are unpaid, shall be acceptable only if it be received within one month from the beginning of the fiscal year, unless an exception be authorized by special action of the Executive Committee.

## ARTICLE VI.

### AMENDMENTS.

SECTION 1. Proposed amendments to these By-Laws, signed by at last three members, must be presented in writing to the Executive Committee at least four weeks before the next Annual Meeting. In the notices for this meeting the proposed amendments shall be printed. At the Annual Meeting the proposed amendment may be discussed and amended and may be passed to letter ballot by a two-thirds vote of those present.

If two-thirds of the votes obtained by letter ballot are in favor of the proposed amendment, it shall be adopted.

SEC. 2. The Executive Committee is authorized to number the Articles and Sections of the By-Laws to correspond with any changes that may be made.

## GENERAL INFORMATION.

### INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.

*Historical.*—The International Association for Testing Materials had its origin in a conference of a small group of workers in experimental engineering held in Munich in 1882, at the instance chiefly of the late John Bauschinger. Meetings on a larger scale were subsequently held in Dresden (1884), Berlin (1886), Munich (1888), Vienna (1893), and Zurich (1895). At the Zurich Congress the International Association for Testing Materials was formally organized, the Second Congress was held at Stockholm in 1897, the Third Congress met at Budapest in 1901, the Fourth Congress met at Brussels in 1906, and the Fifth Congress met at Copenhagen in 1909. The Sixth Congress will be held in the United States in 1912, at a time and place not yet determined.

*Membership.*—According to the latest official report (April, 1910), the membership is distributed as follows:

| | | | | | |
|---|---|---|---|---|---|
| Germany | 400 | Hungary | 93 | Luxembourg | 10 |
| United States | *381 | Switzerland | 90 | Canada | 8 |
| Russia (Finland, 33) | 304 | Belgium | 82 | Brazil | 4 |
| Austria | 224 | Italy | 64 | Chili | 3 |
| France | 186 | Sweden | 64 | Japan | 3 |
| Denmark | 155 | Norway | 50 | Panama | 3 |
| Great Britain | 136 | Holland | 44 | Servia | 2 |
| Spain | 95 | Australia | 25 | Argentine Republic | 1 |
| | | Roumania | 21 | Greece | 1 |
| | | Portugal | 14 | | |

Total (representing 27 countries) . . . . . . . . . . . . . . . . . 2,463

*Objects.*—The objects of the Association, as set forth in its by-laws,† are: "The development and unification of standard methods of testing; the examination of the technically important properties of materials of construction and other materials of practical value, and also the perfecting of apparatus used for this purpose." The important subject of specifications has, however, also been included more recently within the scope of the Association's activity.

*The American membership is now (September, 1910) 420.

†These by-laws are given in full on pp. 249-252.

*Administration.*—The affairs of the Association are administered by a Council, consisting of the President and one representative (member of Council) from each country having a membership of twenty or more.

*Methods.*—The original plan was to conduct investigations almost exclusively through the agencies of international committees. These committees proved unwieldly, however, by reason of their large membership, with the added difficulties arising from geographical separation and differences of language. In pursuance of resolutions at the Budapest Congress (1901) the Council has discharged some of these committees, re-assigning the problems in part to individual referees.* In the case of questions of direct international concern, the original international committees are continued. At the International Congresses the reports of these committees as well as individual contributions by members are presented and discussed.

*Publications.*—The publications of the International Association consist of Proceedings, issued in pamphlet form at irregular intervals during the year, of which the first number was published in May, 1908, and the last to date, No. 16, in May, 1910. These Proceedings are printed in German, English and French, and contain the papers and committee reports presented at the International Congresses, the minutes of the Council, official communications, membership lists, personnel of technical committees, etc.†

## ORGANIZATION OF THE AMERICAN MEMBERS OF THE INTERNATIONAL ASSOCIATION.

*Historical.*—With a view of bringing the members of like nationality into closer relations among themselves, and in order to simplify the management and render the work of the International Association more effective, it was decided at the Stockholm

* For complete list of problems, committees and referees, see pp. 253-259.

† The Proceedings of the Fifth Congress, held at Copenhagen in 1909, are contained in pamphlets Nos. 5-15 incl., the contents aggregating about 1,000 pages. Copies of the English edition of these Proceedings, bound in cloth, may be obtained at the price of $5.00 per volume from the McGraw-Hill Book Company, American agents for the publications of the International Association, 239 West Thirty-ninth Street, New York.

The papers presented at the Brussels Congress, 1906, may be obtained at the following prices:

| | |
|---|---|
| Official Papers, per set | $1.50 |
| Non-Official Papers, per set | 2.50 |

Separate copies of above papers, 10-20 cents.

A list of these official and non-official papers may be had by addressing Edgar Marburg, University of Pennsylvania, Philadelphia.

Congress (1897) to encourage the consolidation of the membership in the various countries into separate national organizations. In pursuance of this action the American members met in Philadelphia on June 16, 1898, and organized under the name of the "American Section of the International Association for Testing Materials."

In March, 1902, the Executive Committee of the American Section applied for a Charter under the laws of the State of Pennsylvania for purposes of incorporation under the proposed new name of the "American Society for Testing Materials." This Charter was duly granted, and at the Fifth Annual Meeting, held at Atlantic City, N. J., it was unanimously adopted on June 12, 1902.

At the Eighth Annual Meeting (1905), the By-Laws were amended with a view of leaving membership in the International Association to the individual option of the members of the American Society. This amendment was adopted by letter ballot of the Society.

*Objects.*—The objects of the Society are essentially identical with those of the International Association, with which it stands in direct organic relation, both through its membership in the same as a body, and through the individual membership on the part of many of its members.

As stated in the Charter: "The corporation is formed for the promotion of knowledge of the materials of engineering, and the standardization of specifications and the methods of testing."

The standardization of specifications is considered one of the most important functions of the Society. The method of procedure is to submit proposed standard specifications prepared by the various committees for general discussion at the annual meetings of the Society. The specifications in their original or amended form may then be referred, by two-thirds vote of those voting, to letter ballot of the Society subject to adoption as Standard Specifications by two-thirds vote of those voting. A list of the Standard Specifications thus far adopted by the Society is given on pages 16-19.

*Representation on the International Council.*—The American members are entitled to one representative on the International Council. By the By-Laws of the Association (1909): "Every country represented in the Association by at least twenty members has the right to elect one member as member of the Council." According to the By-Laws of the American Society, the President is "*ex officio*" the American Member of the Council of the International Association.

*Meetings.*—The Society meets annually at a time and place fixed by the Executive Committee. Special meetings may also be called in accordance with the provisions of the by-laws.

*Membership.*—The number of American members at the time of the organization meeting in 1898 was 70. The membership reported at the successive annual meetings was as follows: (1899) 128, (1900) 160, (1901) 168, (1902) 175, (1903) 349, (1904) 485, (1905) 677, (1906) 835, (1907) 925, (1908) 1,015, (1909) 1,160, (1910) 1,280.

*Methods.*—The operations of the Society are conducted in part under the auspices of the International Association, but for the most part independently.

The number of American representatives on international committees is fixed by the International Council. These American sub-committees are authorized, however, to increase their number, at pleasure, subject always to the approval of the Executive Committee of the American Society. The sense of these enlarged sub-committees on all questions is determined by majority vote; but on the international committees the representation and the number of votes allowed remain as originally fixed by the International Council.

The American Society appoints other committees at its discretion entirely independently of the International Association. On committees concerned with subjects involving commercial interests, the policy is to accord equal numerical representation to engineers or scientists, and to manufacturers.

Many of these committees have rendered a useful service in the origination of proposed standard specifications for materials and for methods of testing. Such proposed specifications on approval by majority vote of the committees concerned are submitted to the Society at its annual meetings, when the specifications may be discussed, amended, and referred to letter ballot of the Society by two-thirds vote of those voting. The final adoption of the specifications by letter ballot is contingent on an affirmative two-thirds vote of those voting.

The personnel of the Technical Committees of the American Society is indicated on pages 235-244.

*Publications.*—The publications of the Society appeared originally at irregular intervals in the form of bulletins. Twenty-eight bulletins, containing a total of 266 pages, were thus issued. Since 1902 the Proceedings have appeared in the form of annual volumes. In passing to this new plan of publication the twenty-eight bulletins previously issued were counted collectively as

Volume I. The Table of Contents of all publications issued by the Society, with price list, is given on pages 292-308.

In 1910, the Society began the publication of a Year-Book in cloth binding, containing all the standard specifications in their latest revised form, besides the by-laws, list of members, committees, and other information concerning the Society. The standard specifications are also published in separate form. The price list for the Year-Book and for the separate specifications is given on page 19.

# LIST OF STANDARD SPECIFICATIONS

ADOPTED BY THE

AMERICAN SOCIETY FOR TESTING MATERIALS



1. Standard Specifications for Structural Steel for Bridges.*
   Proposed May, 1900 (Vol. I, pp. 81-86).
   Adopted in amended form August 10, 1901 (Vol. I, p. 250).
   First revision adopted September 1, 1905 (Vol. V, pp. 48-52).
   Second revision adopted August 16, 1909 (Vol. IX, pp. 37-41).

2. Standard Specifications for Structural Steel for Buildings.
   Proposed May, 1900 (Vol. I, pp. 87-92).
   Adopted in amended form August 10, 1901 (Vol. I, p. 250).
   First revision adopted August 16, 1909 (Vol. IX, pp. 47-50).

3. Standard Specifications for Structural Steel for Ships.*
   Proposed May, 1900 (Vol. I, pp. 81-86).
   Adopted in amended form August 10, 1901 (Vol. I, p. 250).
   First revision adopted August 16, 1909 (Vol. IX, pp. 42-46).

4. Standard Specifications for Open-Hearth Boiler Plate and Rivet Steel.
   Proposed May, 1900 (Vol. I, pp. 93-99).
   Adopted in amended form August 10, 1901 (Vol. I, p. 251).
   First revision adopted August 16, 1909 (Vol. IX, pp. 51-55).

5. Standard Specifications for Bessemer Steel Rails.†
   Proposed May, 1900 (Vol. I, pp. 101-105).
   Adopted in amended form August 10, 1901 (Vol. I, p. 253).
   First revision adopted September 1, 1907 (Vol. VII, pp. 44-47).
   Second revision adopted August 15, 1908 (Vol. VIII, pp. 44-47).
   Third revision adopted August 16, 1909 (Vol. IX, pp. 62-65).

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* These two specifications, when first adopted in 1901, were combined under the title "Standard Specifications for Structural Steel for Bridges and Ships." In 1905, these specifications were made to apply to ship material only, by striking out the words "*Bridges and*" from the title, and revised "Standard Specifications for Structural Stee for Bridges" were adopted.

† These specifications were designated "Standard Specifications for Steel Rails," till the adoption, August 16, 1909, of separate "Standard Specifications for Open-Hearth Steel Rails."

6. Standard Specifications for Open-Hearth Steel Rails.
   Proposed June, 1909.
   Adopted August 16, 1909 (Vol. IX, pp. 66–69).

7. Standard Specifications for Steel Splice Bars.
   Proposed May, 1900 (Vol. I, pp. 107-109).
   Adopted in amended form August 10, 1901 (Vol. I, p. 253).
   First revision adopted August 16, 1909 (Vol. IX, pp. 56-57).

8. Standard Specifications for Steel Axles.
   Proposed May, 1900 (Vol. I, pp. 111-114).
   Adopted in amended form August 10, 1901 (Vol. I, p. 254).
   First revision adopted September 1, 1905 (Vol. V, pp. 56-58).

9. Standard Specifications for Steel Tires.
   Proposed May, 1900.
   Adopted August 10, 1901 (Vol. I, pp. 115-118).
   First revision adopted August 16, 1909 (Vol. IX, pp. 58-61).

10. Standard Specifications for Steel Forgings.
    Proposed May, 1900 (Vol. I, pp. 119-123).
    Adopted in amended form August 10, 1901 (Vol. I, p. 254).
    First revision adopted September 1, 1905 (Vol. V, pp. 59-62).

11. Standard Specifications for Steel Castings.
    Proposed May, 1900.
    Adopted August 10, 1901 (Vol. I, pp. 125-128).
    First revision adopted September 1, 1905 (Vol. V, pp. 53-55).

12. Standard Specifications for Wrought Iron.
    Proposed May, 1900 (Vol. I, pp. 129-134).
    Adopted in amended form August 10, 1901 (Vol. I, pp. 231-235). See also Vol. I, p. 254.

13. Standard Specifications for Foundry Pig Iron.
    Proposed June, 1904 (Vol. IV, p. 44).
    Adopted in amended form November 15, 1904 (Vol. IV, pp. 103-104).
    First revision adopted August 16, 1909 (Vol. IX, pp. 111-112).

14. Standard Specifications for Cast-Iron Pipe and Special Castings.
    Proposed June, 1904.
    Adopted November 15, 1904 (Vol. IV, pp. 57-66).

15. Standard Specifications for Locomotive Cylinders.
    Proposed June, 1904 (Vol. IV, pp. 69-70).
    Adopted in amended form November 15, 1904 (Vol. IV, p. 69).

16. Standard Specifications for Cast-Iron Car Wheels.
    Proposed June, 1904 (Vol. IV, pp. 74-79).
    Adopted in amended form September 1, 1905 (Vol. V, pp. 65-70).

17. Standard Specifications for Gray-Iron Castings.
    Proposed June, 1904 (Vol. IV, pp. 97-100).
    Adopted in amended form September 1, 1905 (Vol. V, pp. 71-74).

18. Standard Specifications for Malleable Castings.
    Proposed June, 1904 (Vol. IV, pp. 95-96).
    Adopted in amended form November 15, 1904 (Vol. IV, p. 96).

19. Standard Specifications for Staybolt Iron.
    Proposed June, 1907 (Vol. VII, pp. 157-158).
    Adopted in amended form September 1, 1910 (Vol. X, pp. —).

20. Standard Specifications for Hard-Drawn Copper Wire.
    Proposed June, 1909.
    Adopted August 16, 1909 (Vol. IX, pp. 311-318).

21. Standard Specifications for Cement.
    Proposed June, 1904.
    Adopted November 15, 1904 (Vol. IV, pp. 105-119).
    First revision adopted August 15, 1908 (Vol. VIII, pp. 149-164).
    Second revision adopted August 16, 1909 (Vol. IX, pp. 116-130).

22. Standard Classification of Structural Timber.*
    I. Definition of Structural Timber.
    II. Standard Defects.
    III. Standard Names for Structural Timber.
    Proposed June, 1906 (Vol. VI, pp. 129-133).
    Adopted in amended form September 1, 1907 (Vol. VII, pp. 187-192).

23. Standard Specifications for Yellow-Pine Bridge and Trestle Timbers.
    Proposed June, 1909 (Vol. IX, pp. 283-286).
    Adopted September 1, 1910 (Vol. X, pp. —).

24. Standard Test for Fireproof Floor Construction.
    Proposed June, 1906 (Vol. VI, pp. 126-128).
    Adopted September 1, 1907 (Vol. VII, pp. 179-180).
    First revision adopted August 15, 1908 (Vol. VIII, pp. 210-212).

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* These specifications originally included "Standard Specifications for Bridge and Trestle Timbers," and were designated "Standard Specifications for Structural Timber" till the adoption, September 1, 1910, of separate "Standard Specifications for Yellow-Pine Bridge and Trestle Timbers."

25. Standard Test for Fireproof Partition Construction.
    Proposed June, 1908 (Vol. VIII, pp. 207-209).
    Adopted August 16, 1909 (Vol IX, pp. 281-282).

26. Standard Abrasion Test for Road Material.
    Proposed June, 1904 (Vol. IV, pp. 193-194).
    Adopted August 15, 1908 (Vol. VIII, pp. 197-198).

27. Standard Toughness Test for Macadam Rock.
    Proposed June, 1905 (Vol. V, pp. 102-103).
    Adopted August 15, 1908 (Vol. VIII, pp. 199-200).

28. Standard Methods of Testing.
    I. Methods for Tensile Tests of Metals.
    II. Methods for Compressive Tests of Metals.
    III. Methods for Metallographic Tests of Metals.
    Proposed June, 1909 (Vol. IX, pp. 263-272).
    Adopted September 1, 1910.

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## PRICE LIST OF STANDARD SPECIFICATIONS.

The price of the above Standard Specifications is 25 cents each; 20 cents in lots of ten or more, whether of the same or of different specifications; and 15 cents in lots of twenty-five or more of a single specification. Since the numeric designation of the Standard Specifications is subject to change from year to year, specifications should be ordered by title and not by number. Members of the Society may obtain these specifications at the following special prices: single copies, 15 cents; in lots of ten or more, 10 cents; complete sets, $2.50.

The price of the Year-Book in cloth binding containing all of these Standard Specifications in their latest revised form is $5.00. Libraries, publishers and book-dealers are allowed a discount of 20 per cent.

## EXTRACT RELATING TO SPECIFICATIONS

FROM

## REGULATIONS GOVERNING TECHNICAL COMMITTEES.

Proposed new and standard specifications or the proposed amendment of existing specifications must originate in the particular committee within whose province such specifications properly belong. No action affecting specifications shall be taken by any technical committee except at meetings called for that purpose. Action at such meetings shall be subject to majority vote of those voting, and subsequently to majority vote of those voting on letter ballot of the entire committee. Dissenting members shall have the right to present minority reports, individually or jointly, at the annual meeting of the Society at which the majority report is presented.

Any recommendations affecting specifications presented by the appropriate committees at the annual meetings of the Society may be amended by a majority vote of those voting, and the final adoption of new or amended specifications shall be subject to the following procedure:

1. Approval at an annual meeting by two-thirds vote of those voting.
2. Approval by letter ballot of the Society by two-thirds vote of those voting.

# AMERICAN SOCIETY FOR TESTING MATERIALS

PHILADELPHIA, PA., U. S. A.

AFFILIATED WITH THE

INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.

## STANDARD SPECIFICATIONS FOR STRUCTURAL STEEL FOR BRIDGES.

ADOPTED AUGUST 16, 1909.

1. Steel shall be made by the open-hearth process. **Manufacture.**

2. The chemical and physical properties shall conform to the following limits: **Chemical Composition.**

| Properties Considered. | Structural Steel. | Rivet Steel. | Steel Castings |
|---|---|---|---|
| Phosphorus, Max. Basic | 0.04 per cent. | 0.04 per cent. | 0.05 per cent. |
| Phosphorus, Max. Acid | 0.06 " | 0.04 " | 0.08 " |
| Sulphur, Max. ........ | 0.05 " | 0.04 " | 0.05 " |
| Ult. tensile strength .. Pounds per sq. in... | Desired. 60,000 | Desired 50,000 | Not less than 65,000 |
| Elong.: Min. per cent. in 8 in. (Fig. 1) .... | $\frac{1,500,000^*}{\text{Ult. tens. str.}}$ | $\frac{1,500,000}{\text{Ult. tens. str.}}$ | |
| Elong.: Min. per cent. in 2 in. (Fig. 2) .... | 22 | .............. | 18 |
| Character of fracture . | Silky | Silky | Silky or fine granular. |
| Cold bend without fracture ........... | 180 degrees flat† | 180 degrees flat‡ | 90 degrees. d = 3t |

* See par. 11. † See par. 12, 13 and 14. ‡ See par. 15.

The yield point, as indicated by the drop of beam, shall be recorded in the test reports.

3. If the ultimate strength varies more than 4,000 lbs. from that desired, a retest may be made, at the discretion of the inspector, on the same gauge, which, to be acceptable, shall be within 5,000 lbs. of the desired ultimate. **Retests.**

**Chemical Determination.** 4. Chemical determinations of the percentages of carbon, phosphorus, sulphur and manganese shall be made by the manufacturer from a test ingot taken at the time of the pouring of each melt of steel and a correct copy of such analysis shall be furnished to the engineer or his inspector. Check analyses shall be made from finished material, if called for by the purchaser, in which case an excess of 25 per cent. above the required limits will be allowed.

**Plates, Shapes and Bars.** 5. Specimens for tensile and bending tests for plates, shapes and bars shall be made by cutting coupons from the finished pro-

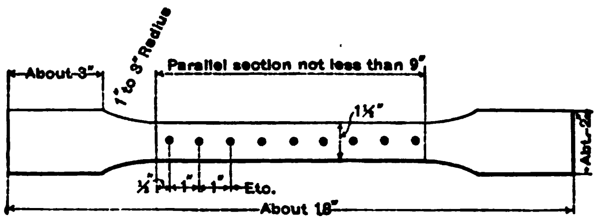


FIG. 1.

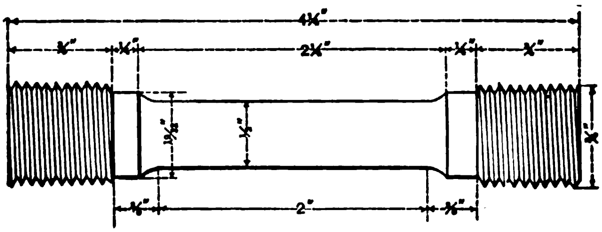


FIG. 2.

duct, which shall have both faces rolled and both edges milled to the form shown by Fig. 1; or with both edges parallel; or they may be turned to a diameter of ¾ inch for a length of at least 9 inches, with enlarged ends.

**Rivets.** 6. Rivet rods shall be tested as rolled.

**Pins and Rollers.** 7. Specimens shall be cut from the finished rolled or forged bar in such manner that the center of the specimen shall be 1 inch from the surface of the bar. The specimen for tensile test shall be turned to the form shown by Fig. 2. The specimen for bending test shall be 1 inch by ½ inch in section.

**Steel Castings.** 8. The number of tests will depend on the character and importance of the castings. Specimens shall be cut cold from

coupons molded and cast on some portion of one or more castings from each melt or from the sink-heads, if the heads are of sufficient size. The coupon or sink-head, so used, shall be annealed with the casting before it is cut off. Test specimens to be of the form prescribed for pins and rollers.

**Conditions for Tests.** 9. Material which is to be used without annealing or further treatment shall be tested in the condition in which it comes from the rolls. When material is to be annealed or otherwise treated before use, the specimens for tensile tests representing such material shall be cut from properly annealed or similarly treated short lengths of the full section of the bar.

**Number of Tests.** 10. At least one tensile and one bending test shall be made from each melt of steel as rolled. In case steel differing $\frac{3}{8}$ inch and more in thickness is rolled from one melt, a test shall be made from the thickest and thinnest material rolled.

**Elongation.** 11. For material less than $\frac{5}{16}$ inch and more than $\frac{3}{4}$ inch in thickness the following modifications will be allowed in the requirements for elongation:

(*a*) For each $\frac{1}{16}$ inch in thickness below $\frac{5}{16}$ inch, a deduction of $2\frac{1}{2}$ will be allowed from the specified percentage.

(*b*) For each $\frac{1}{8}$ inch in thickness above $\frac{3}{4}$ inch, a deduction of 1 will be allowed from the specified percentage.

**Bending Tests.** 12. Bending tests may be made by pressure or by blows. Plates, shapes and bars less than 1 inch thick shall bend as called for in Paragraph 2.

**Full-sized Bends.** 13. Full-sized material for eye-bars and other steel 1 inch thick and over, tested as rolled, shall bend cold 180° around a pin the diameter of which is equal to twice the thickness of the bar, without fracture on the outside of bend.

**Tests for Angles.** 14. Angles $\frac{3}{4}$ inch and less in thickness shall open flat, and angles $\frac{1}{2}$ inch and less in thickness shall bend shut, cold, under blows of a hammer, without sign of fracture. This test will be made only when required by the inspector.

**Tests on Rivet Steel.** 15. Rivet steel, when nicked and bent around a bar of the same diameter as the rivet rod, shall give a gradual break and a fine, silky, uniform fracture.

**Finish.** 16. Finished material shall be free from injurious seams, flaws, cracks, defective edges, or other defects, and have a smooth

uniform, workmanlike finish. Plates 36 inches in width and under shall have rolled edges.

**Marking.** 17. Every finished piece of steel shall have the melt number and the name of the manufacturer stamped or rolled upon it. Steel for pins and rollers shall be stamped on the end. Rivet and lattice steel and other small parts may be bundled with the above marks on an attached metal tag.

**Rejections.** 18. Material which, subsequent to the above tests at the mills and its acceptance there, develops weak spots, brittleness, cracks or other imperfections, or is found to have injurious defects, will be rejected at the shop and shall be replaced by the manufacturer at his own cost.

**Permissible Variations.** 19. A variation in cross-section or weight of each piece of steel of more than 2½ per cent. from that specified will be sufficient cause for rejection, except in case of sheared plates, which will be covered by the following permissible variations, which are to apply to single plates.

### WHEN ORDERED TO WEIGHT.

*Plates 12½ pounds per square foot or heavier:*

(*c*) Up to 100 inches wide, 2½ per cent. above or below the prescribed weight.

(*d*) 100 inches wide and over, 5 per cent. above or below.

*Plates under 12½ pounds per square foot:*

(*e*) Up to 75 inches wide, 2½ per cent. above or below.

(*f*) 75 inches and up to 100 inches wide, 5 per cent. above or 3 per cent. below.

(*g*) 100 inches wide and over, 10 per cent. above or 3 per cent. below.

### WHEN ORDERED TO GAUGE.

Plates will be accepted if they measure not more than 0.01 inch below the ordered thickness.

An excess over the nominal weight corresponding to the dimensions on the order, will be allowed for each plate, if not more than that shown in the following tables, one cubic inch of rolled steel being assumed to weigh 0.2833 pound.

*Plates ¼ inch and over in thickness.*

| Thickness Ordered. Inches. | Nominal Weights. Lbs. | Width of Plate. | | | |
|---|---|---|---|---|---|
| | | Up to 75 in. | 75 in. and up to 100 in. | 100 in. and up to 115 in. | Over 115 in. |
| 1-4 | 10.20 | 10 per cent. | 14 per cent. | 18 per cent. | ............ |
| 5-16 | 12.75 | 8 " " | 12 " " | 16 " " | ............ |
| 5-8 | 15.30 | 7 " " | 10 " " | 13 " " | 17 per cent. |
| 7-16 | 17.85 | 6 " " | 8 " " | 10 " " | 13 " " |
| 1-2 | 20.40 | 5 " " | 7 " " | 9 " " | 12 " " |
| 9-16 | 22.95 | 4½ " " | 6½ " " | 8½ " " | 11 " " |
| 5-8 | 25.50 | 4 " " | 6 " " | 8 " " | 10 " " |
| Over 5-8 | ........ | 3½ " " | 5 " " | 6½ " " | 9 " " |

*Plates under ¼ inch in thickness.*

| Thickness Ordered. Inches. | Nominal Weights. Lbs. per sq. ft. | Width of Plate. | | |
|---|---|---|---|---|
| | | Up to 50. in. | 50 in. and up to 70 in. | Over 70 in. |
| 1-8 up to 5-32 | 5.10 to 6.37 | 10 per cent. | 15 per cent. | 20 per cent. |
| 5-32 " 3-16 | 6.37 " 7.65 | 8½ " " | 12½ " " | 17 " " |
| 3-16 " 1-4 | 7.65 " 10.20 | 7 " " | 10 " " | 15 " " |

20. The purchaser shall be furnished complete copies of mill orders, and no material shall be rolled, nor work done, before the purchaser has been notified where the orders have been placed, so that he may arrange for the inspection. **Inspection and Testing.**

21. The manufacturer shall furnish all facilities for inspecting and testing the weight and quality of all material at the mill where it is manufactured. He shall furnish a suitable testing machine for testing the specimens, as well as prepare the pieces for the machine, free of cost.

22. When an inspector is furnished by the purchaser to inspect material at the mills, he shall have full access, at all times, to all parts of mills where material to be inspected by him is being manufactured.

AMERICAN SOCIETY FOR TESTING MATERIALS

PHILADELPHIA, PA., U. S. A.

AFFILIATED WITH THE

INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.


# STANDARD SPECIFICATIONS FOR STRUCTURAL STEEL FOR BUILDINGS.

ADOPTED AUGUST 16, 1909.

**Manufacture.** 1. Structural steel may be made by either the open-hearth or Bessemer process.

Rivet steel and plate or angle material over ¾ inch thick, which is to be punched, shall be made by the open-hearth process.

**Chemical and Physical Properties.** 2. The chemical and physical properties shall conform to the following limits:

| Properties Considered. | Structural Steel. | Rivet Steel, Open Hearth. |
|---|---|---|
| Phosphorus, max., Bessemer | 0.10 per cent. | |
| Phosphorus, max., open hearth | 0.06 " | 0.06 per cent. |
| Ult. tensile strength, pounds per sq. in | 55,000–65,000 | 48,000–58,000 |
| Yield point | ½ Ult. tens. str. | ½ Ult. tens. str. |
| Elongation, min. per cent. in 8 ins., (Fig. 1) | $\frac{1,400,000^*}{\text{Ult. tens. str.}}$ | $\frac{1,400,000}{\text{Ult. tens. str.}}$ |
| Character of fracture | Silky | Silky |
| Cold bend without fracture | 180° to diameter of 1 thickness | 180° flat |

* See paragraph 7.

For the purposes of these specifications, the yield point shall be determined by the careful observation of the drop of the beam or halt in the gauge of the testing machine.

**Chemical Determinations.**

3. In order to determine if the material conforms to the chemical limitations prescribed in Paragraph 2 herein, analysis shall be made by the manufacturer from a test ingot taken at the time of the pouring of each melt or blow of steel, and a correct copy of such analysis shall be furnished to the engineer or his inspector.

**Form of Specimens.**

4. Specimens for tensile and bending tests shall be made by cutting coupons from the finished product, which shall have both faces rolled and both edges milled to the form shown by Fig. 1; or with both edges parallel; or they may be turned to a diameter of $\frac{3}{4}$ inch for a length of at least 9 inches, with enlarged ends.

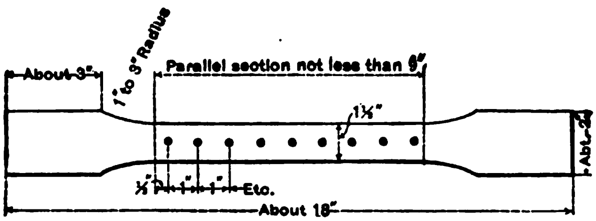


FIG. 1.

(*a*) For material more than $\frac{3}{4}$ inch thick the bending test specimen may be 1 inch by $\frac{1}{2}$ inch in section.

(*b*) Rivet rounds and small rolled bars shall be tested as rolled.

**Annealed Specimens.**

5. Material which is to be used without annealing or further treatment shall be tested in the condition in which it comes from the rolls. When material is to be annealed or otherwise treated before use, the specimens for tensile tests, representing such material, shall be cut from properly annealed or similarly treated short lengths of the full section of the bar.

**Number of Tests.**

6. At least one tensile and one bending test shall be made from each melt or blow of steel as rolled. In case steel differing $\frac{3}{8}$ inch and more in thickness is rolled from one melt or blow, a test shall be made from the thickest and thinnest material rolled. Should either of these test specimens develop flaws, or should the tensile test specimen break outside of the middle third of its gauged length, it may be discarded and another test specimen

substituted therefor. In case a tensile test specimen does not meet the specification, additional tests may be made.

(*c*) The bending test may be made by pressure or by blows.

**Modifications in Elongation for Thin and Thick Material.**

7. For material less than $\frac{5}{16}$ inch and more than $\frac{3}{4}$ inch in thickness, the following modifications shall be made in the requirements for elongation:

(*d*) For each increase of $\frac{1}{8}$ inch in thickness above $\frac{3}{4}$ inch, a deduction of 1 shall be made from the specified percentage of elongation.

(*e*) For each decrease of $\frac{1}{16}$ inch in thickness below $\frac{5}{16}$ inch, a deduction of $2\frac{1}{2}$ shall be made from the specified percentage of elongation.

(*f*) For pins, the required percentage of elongation shall be 5 less than that specified in Paragraph 2, as determined on a test specimen, the center of which shall be 1 inch from the surface.

**Finish.**

8. Finished material must be free from injurious seams, flaws, or cracks, and have a workmanlike finish.

**Branding.**

9. Test specimens and every finished piece of steel shall be stamped with melt or blow number, except that small pieces may be shipped in bundles securely wired together, with the melt or blow number on a metal tag attached.

**Variation in Weight.**

10. A variation in cross-section or weight of each piece of steel of more than $2\frac{1}{2}$ per cent. from that specified will be sufficient cause for rejection, except in case of sheared plates, which will be covered by the following permissible variations, which are to apply to single plates.

### WHEN ORDERED TO WEIGHT.

*Plates* $12\frac{1}{2}$ *pounds per square foot or heavier:*

(*g*) Up to 100 inches wide, $2\frac{1}{2}$ per cent. above or below the prescribed weight.

(*h*) 100 inches wide and over, 5 per cent. above or below.

*Plates under* $12\frac{1}{2}$ *pounds per square foot:*

(*i*) Up to 75 inches wide, $2\frac{1}{2}$ per cent. above or below.
75 inches and up to 100 inches wide, 5 per cent. above or 3 per cent. below.

(*j*) 100 inches wide and over, 10 per cent. above or 3 per cent. below.

### WHEN ORDERED TO GAUGE.

Plates will be accepted if they measure not more than 0.01 inch below the ordered thickness.

An excess over the nominal weight corresponding to the dimensions on the order will be allowed for each plate, if not more than that shown in the following tables, one cubic inch of rolled steel being assumed to weigh 0.2833 pound.

*Plates ¼ inch and over in thickness.*

| Thickness Ordered. Inches. | Nominal Weights. Lbs. per sq. ft. | Width of Plate. | | | |
|---|---|---|---|---|---|
| | | Up to 75 ins. | 75 ins. and up to 100 ins. | 100 ins. and up to 115 ins. | Over 115 ins. |
| 1-4 | 10.20 | 10 per cent. | 14 per cent. | 18 per cent. | |
| 5-16 | 12.75 | 8 " | 12 " | 16 " | |
| 3-8 | 15.30 | 7 " | 10 " | 13 " | 17 per cent. |
| 7-16 | 17.85 | 6 " | 8 " | 10 " | 13 " |
| 1-2 | 20.40 | 5 " | 7 " | 9 " | 12 " |
| 9-16 | 22.95 | 4½ " | 6½ " | 8½ " | 11 " |
| 5-8 | 25.50 | 4 " | 6 " | 8 " | 10 " |
| Over 5-8 | ..... | 3½ " | 5 " | 6½ " | 9 " |

*Plates under ¼ inch in thickness.*

| Thickness Ordered. Inches. | Nominal Weights. Lbs. per sq. ft. | Width of Plate. | | |
|---|---|---|---|---|
| | | Up to 50 ins. | 50 ins. and up to 70 ins. | Over 70 ins. |
| 1-8 up to 5-32 | 5.10 to 6.37 | 10 per cent. | 15 per cent. | 20 per cent. |
| 5-32 " 3-16 | 6.37 to 7.65 | 8½ " | 12½ " | 17 " |
| 3-16 " 1-4 | 7.65 to 10.20 | 7 " | 10 " | 15 " |

11. The inspector representing the purchaser shall have all reasonable facilities afforded to him by the manufacturer to satisfy him that the finished material is furnished in accordance with these specifications. Inspection.

All tests and inspections shall be made at the place of manufacture, prior to shipment.

# AMERICAN SOCIETY FOR TESTING MATERIALS

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## STANDARD SPECIFICATIONS FOR STRUCTURAL STEEL FOR SHIPS.

ADOPTED AUGUST 16, 1909.

**Manufacture.** 1. Steel shall be made by the open-hearth process.

**Chemical and Physical Properties.** 2. The chemical and physical properties shall conform to the following limits:

| Properties Considered. | Structural Steel. | Rivet Steel. | Steel Castings. |
|---|---|---|---|
| Phosphorus, max. { Basic / Acid | 0.04 per cent.<br>0.06 " | 0.04 per cent.<br>0.06 " | 0.05 per cent.<br>0.08 " |
| Sulphur, max. | ........ | 0.05 " | ........ |
| Ult. tensile strength, pounds per sq. in. | 55,000–65,000 | 48,000–58,000 | 60,000 minimum |
| Yield point | ½ Ult. tens. str. | ½ Ult. tens. str. | ½ Ult. tens. str. |
| Elong., min. per cent. in 8 in. (Fig. 1) | $\frac{1,500,000}{\text{Ult. tens. str.}}$ | $\frac{1,500,000}{\text{Ult. tens. str.}}$ | ........ |
| Elong., min. per cent. in 2 in. (Fig. 2) | ........ | ........ | 18 |
| Character of fracture | Silky | Silky | Silky or fine granular. |
| Cold bend without fracture | 180° flat | 180° flat | 90°<br>d = 3t. |

For the purposes of these specifications, the yield point shall be determined by the careful observation of the drop of the beam or halt in the gauge of the testing machine. **Yield Point.**

3. In order to determine if the material conforms to the chemical limitations prescribed in Paragraph 2 herein, analysis shall be made by the manufacturer from a test ingot taken at the time of the pouring of each melt of steel, and a correct copy of such analysis shall be furnished to the engineer or his inspector. A check analysis may be made by the purchaser or his representative if desired, in which case an excess of 25 per cent. above the required limits will be allowed. **Chemical Determinations.**

4. Specimens for tensile and bending tests for structural and rivet steel shall be made by cutting coupons from the finished **Form of Specimens.**

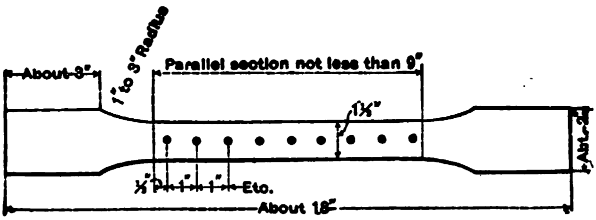


FIG. 1.

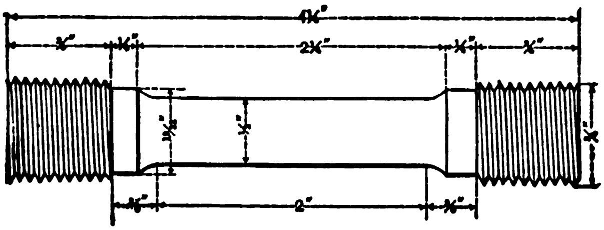


FIG. 2.

product, which shall have both faces rolled and both edges milled to the form shown by Fig. 1; or with both edges parallel; or they may be turned to a diameter of ¾ inch for a length of at least 9 inches, with enlarged ends.

(*a*) Rivet rounds and small rolled bars shall be tested as rolled.

5. The number of tests will depend on the character and importance of the castings. Specimens shall be cut cold from **Steel Castings.**

coupons molded and cast on some portion of one or more castings from each melt or from the sink-heads, if the heads are of sufficient size. The coupon or sink-head so used shall be annealed with the casting before it is cut off. Test specimens shall be of the form shown by Fig. 2.

**Annealed Specimens.**

6. Material which is to be used without annealing or further treatment shall be tested in the condition in which it comes from the rolls. When material is to be annealed or otherwise treated before use, the specimens for tensile tests, representing such material, shall be cut from properly annealed or similarly treated short lengths of the full section of the bar.

**Number of Tests.**

7. At least one tensile and one bending test shall be made from each melt of steel as rolled. In case steel differing $\frac{3}{8}$ inch and more in thickness is rolled from one melt, a test shall be made from the thickest and thinnest material rolled. Should either of these test specimens develop flaws, or should the tensile test specimen break outside of the middle third of its gauged length, it may be discarded and another test specimen substituted therefor. In case a tensile test specimen does not meet the specifications, additional tests may be made.

**Modifications in Elongation for Thin and Thick Material.**

8. For material less than $\frac{5}{16}$ inch and more than $\frac{3}{4}$ inch in thickness, the following modifications will be allowed in the requirements for elongation:

(*b*) For each $\frac{1}{16}$ inch in thickness below $\frac{5}{16}$ inch, a deduction of $2\frac{1}{2}$ will be allowed from the specified percentage.

(*c*) For each $\frac{1}{8}$ inch in thickness above $\frac{3}{4}$ inch, a deduction of 1 will be allowed from the specified percentage.

**Bending Tests.**

9. Plates, shapes and bars less than $\frac{3}{4}$ inch thick shall bend as called for in Paragraph 2.

(*d*) Steel $\frac{3}{4}$ inch to $1\frac{1}{4}$ inches thick, inclusive, tested as rolled, shall bend cold 180° around a pin the diameter of which is equal to one and one-half times the thickness of the bar, without fracture on the outside of bend.

(*e*) Steel over $1\frac{1}{4}$ inches thick, tested as rolled, shall bend cold 180° around a pin the diameter of which is equal to twice the thickness of the bar, without fracture on the outside of bend.

(*f*) Bending tests may be made by pressure or by blows.

**Tests on Angles.**

10. Angles $\frac{3}{4}$ inch and less in thickness shall open flat, and angles $\frac{1}{2}$ inch and less in thickness shall bend shut, cold, under

blows of a hammer, without sign of fracture. This test will be made only when required by the inspector.

11. Finished material shall be free from injurious seams, flaws, cracks, defective edges, or other defects, and shall have a smooth, uniform, workmanlike finish. **Finish.**

12. Test specimens and every finished piece of steel shall be stamped with the melt number, except that small pieces may be shipped in bundles securely wired together, with the melt number on a metal tag attached. **Marking.**

13. A variation in cross-section or weight of each piece of steel of more than 2½ per cent. from that specified will be sufficient cause for rejection, except in case of sheared plates, which will be covered by the following permissible variations, which are to apply to single plates. **Variation in Weight.**

### WHEN ORDERED TO WEIGHT.

*Plates 12½ pounds per square foot or heavier:*

(*g*) Up to 100 inches wide, 2½ per cent. above or below the prescribed weight.

(*h*) 100 inches wide and over, 5 per cent. above or below.

*Plates under 12½ pounds per square foot:*

(*i*) Up to 75 inches wide, 2½ per cent. above or below.
75 inches and up to 100 inches wide, 5 per cent. above or 3 per cent. below.

(*j*) 100 inches wide and over, 10 per cent. above or 3 per cent. below.

### WHEN ORDERED TO GAUGE.

Plates will be accepted if they measure not more than 0.01 inch below the ordered thickness.

An excess over the nominal weight corresponding to the dimensions on the order will be allowed for each plate, if not more than that shown in the following tables, one cubic inch of rolled steel being assumed to weigh 0.2833 pound.

*Plates ¼ inch and over in thickness.*

| Thickness Ordered. Inches. | Nominal Weights. Lbs. per sq. ft. | Width of Plate. | | | |
|---|---|---|---|---|---|
| | | Up to 75 ins. | 75 ins. and up to 100 ins. | 100 ins. and up to 115 ins. | Over 115 ins. |
| 1–4 | 10.20 | 10 per cent. | 14 per cent. | 18 per cent. | |
| 5–16 | 12.75 | 8 " | 12 " | 16 " | |
| 3–8 | 15.30 | 7 " | 10 " | 13 " | 17 per cent. |
| 7–16 | 17.85 | 6 " | 8 " | 10 " | 13 " |
| 1–2 | 20.40 | 5 " | 7 " | 9 " | 12 " |
| 9–16 | 22.95 | 4½ " | 6½ " | 8½ " | 11 " |
| 5–8 | 25.50 | 4 " | 6 " | 8 " | 10 " |
| Over 5–8 | ..... | 3½ " | 5 " | 6½ " | 9 " |

*Plates under ¼ inch in thickness.*

| Thickness Ordered. Inches. | Nominal Weights. Lbs. per sq. ft. | Width of Plate. | | |
|---|---|---|---|---|
| | | Up to 50 ins. | 50 ins. and up to 70 ins.* | Over 70 ins. |
| 1–8 up to 5–32 | 5.10 to 6.37 | 10 per cent. | 15 per cent. | 20 per cent. |
| 5–32 " 3–16 | 6.37 to 7.65 | 8½ " | 12½ " | 17 " |
| 3–16 " 1–4 | 7.65 to 10.20 | 7 " | 10 " | 15 " |

**Inspection.** 14. The inspector representing the purchaser shall have all reasonable facilities afforded to him by the manufacturer to satisfy him that the finished material is furnished in accordance with these specifications.

The manufacturer shall furnish a suitable testing machine for testing the specimens, as well as prepare the pieces for the machine, free of cost.

All tests and inspections shall be made at the place of manufacture, prior to shipment.

# AMERICAN SOCIETY FOR TESTING MATERIALS

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## STANDARD SPECIFICATIONS FOR OPEN-HEARTH BOILER PLATE AND RIVET STEEL.

ADOPTED AUGUST 16, 1909.

**Process of Manufacture.**

1. Steel shall be made by the open-hearth process.

**Chemical and Physical Properties.**

2. There shall be three classes of open-hearth boiler plate steel; namely, flange steel, fire box steel and extra soft steel, which shall conform to the following limits in chemical and physical properties:

| | Flange Steel. | Fire Box Steel. | Extra Soft Steel. |
|---|---|---|---|
| Phosphorus shall not exceed .......... | Acid 0.06 per cent.<br>Basic 0.04 " | Acid 0.04 per cent.<br>Basic 0.03 " | 0.04 per cent. |
| Sulphur shall not exceed .......... | 0.05 " | 0.04 " | 0.04 " |
| Manganese......... | 0.30 to 0.60 per cent. | 0.30 to 0.50 per cent. | 0.30 to 0.50 per cent. |
| Ult. tensile strength, pounds per sq. in.. | 55,000–65,000 | 52,000–62,000 | 45,000–55,000 |
| Yield point, in pounds per sq. in., shall not be less than...... | ½ Ult. tens. str. | ½ Ult. tens. str. | ½ Ult. tens. str. |
| Elongation, per cent. in 8 in. shall not be less than ........ | $\frac{1,500,000}{\text{Ult. tens. str.}}$ | $\frac{1,500,000}{\text{Ult. tens. str.}}$ | $\frac{1,500,000}{\text{Ult. tens. str.}}$<br>(but need not exceed 30 per cent.) |
| Cold bend ........<br>Quench bend ...... | 180° flat. | 180° flat. | 180° flat. |

**Yield Point.**

(*a*) For the purposes of these specifications, the yield point shall be determined by the careful observation of the drop of the beam or halt in the gauge of the testing machine.

**Boiler Rivet Steel.**

3. Steel for boiler rivets shall be of the extra soft class, as specified in Paragraph 2.

**Modifications in Elongation for Thin and Thick Material.**

4. For material less than $\frac{5}{16}$ inch and more than $\frac{3}{4}$ inch in thickness, the following modifications shall be made in the requirements for elongation:

(*b*) For each increase of $\frac{1}{8}$ inch in thickness above $\frac{3}{4}$ inch, a deduction of 1 shall be made from the specified percentage of elongation.

(*c*) For each decrease of $\frac{1}{16}$ inch in thickness below $\frac{5}{16}$ inch, a deduction of $2\frac{1}{2}$ shall be made from the specified percentage of elongation.

**Chemical Determinations.**

5. In order to determine if the material conforms to the chemical limitations prescribed in Paragraph 2 herein, analysis shall be made by the manufacturer from a test ingot taken at the time of the pouring of each melt of steel, and a correct copy of such analysis shall be furnished to the engineer or his inspector. A check analysis may be made by the purchaser or his representative, from a broken tensile test specimen representing each heat of flange or extra soft steel on an order, and for each plate as rolled of fire box steel, in which cases an excess of 25 per cent. above the required limits in phosphorus and sulphur will be allowed.

**Test Specimen for Tensile Test.**

6. The standard tensile test specimen of 8-inch gauged length shall be used to determine the physical properties specified in Paragraphs 2 and 3. The standard shape of the tensile test specimen for sheared plates shall be as shown in Fig. 1.

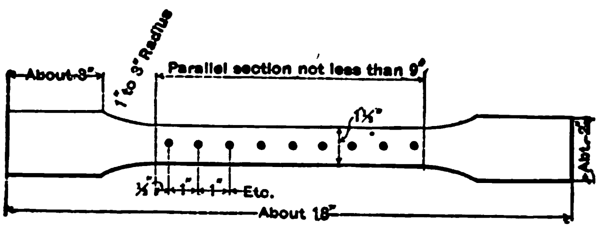


FIG. 1.

For other material the tensile test specimen may be the same as for sheared plates, or it may be planed or turned parallel

throughout its entire length and in all cases where possible two opposite sides of the test specimens shall be the rolled surfaces.

Rivet rounds and small rolled bars shall be tested of full size as rolled.

**Test Specimens for Bending Tests.** 7. The bending test specimen shall be 1½ inches wide, if possible, and for all material ¾ inch or less in thickness the test specimen shall have the natural rolled surface on two opposite sides; but for material more than ¾ inch thick, the bending test specimen may be ½ inch thick. The sheared edges of bending test specimens shall be milled or planed. The bending test may be made by pressure or by blows. The cold bending test shall be made on the material in the condition in which it is to be used, and prior to the quenched bending test, the specimen shall be heated to a light cherry red as seen in the dark and quenched in water, the temperature of which is between 80° and 90° Fahrenheit.

Rivet rounds shall be tested of full size as rolled.

**Homogeneity Tests.** 8. For fire box steel a sample taken from a broken tensile test specimen shall not show any single seam or cavity more than ¼ inch long, in either of the three fractures obtained on the test for homogeneity, as described below:

(*d*) The homogeneity test is made as follows: A portion of the broken tensile test specimen is either nicked with a chisel or grooved on a machine, transversely about $\frac{1}{16}$ inch deep in three places about 2 inches apart. The first groove should be made on one side, 2 inches from the square end of the specimen; the second, 2 inches from it on the opposite side; and the third, 2 inches from the last, and on the opposite side from it. The test specimen is then put in a vise, with the first groove about ¼ inch above the jaws, care being taken to hold it firmly. The projecting end of the test specimen is then broken off by means of a hammer, a number of light blows being used, and the bending being away from the groove. The specimen is broken at the other two grooves in the same way. The object of this treatment is to open and render visible to the eye any seams due to failure to weld up, or to foreign interposed matter, or cavities due to gas bubbles in the ingot. After rupture, one side of each fracture is examined, a pocket lens being used if necessary, and the length of the seams and cavities is determined.

**Number of Tests.** 9. Three test pieces shall be furnished from each plate as it is rolled; one for tension, one for cold bending and one for quench bending test. For rivet rods, two tensile test specimens and two cold bending and two quench bending test specimens shall be furnished from each melt. In case any one of these develops flaws, or should a tensile test specimen break outside of the middle third of its gauged length, it may be discarded and another test specimen substituted therefor.

**Permissible Variations.** 10. A variation in cross-section or weight of each piece of steel of more than 2½ per cent. from that specified will be sufficient cause for rejection, except in case of sheared plates, which will be covered by the following permissible variations, which are to apply to single plates.

### WHEN ORDERED TO WEIGHT.

*Plates 12½ pounds per square foot or heavier:*

(*e*) Up to 100 inches wide, 2½ per cent. above or below the prescribed weight.

(*f*) 100 inches wide and over, 5 per cent. above or below.

*Plates under 12½ pounds per square foot:*

(*g*) Up to 75 inches wide, 2½ per cent. above or below.

(*h*) 75 inches and up to 100 inches wide, 5 per cent. above or 3 per cent. below.

(*i*) 100 inches wide and over, 10 per cent. above or 3 per cent. below

### WHEN ORDERED TO GAUGE.

Plates will be accepted if they measure not more than 0.01 inch below the ordered thickness.

An excess over the nominal weight corresponding to the dimensions on the order will be allowed for each plate, if not more than that shown in the following tables, one cubic inch of rolled steel being assumed to weigh 0.2833 pound.

*Plates ¼ inch and over in thickness.*

| Thickness Ordered. Inches. | Nominal Weights. Lbs. per sq. ft. | Width of Plate. | | | |
|---|---|---|---|---|---|
| | | Up to 75 ins. | 75 ins. and up to 100 ins. | 100 ins. and up to 115 ins. | Over 115 ins. |
| 1–4 | 10.20 | 10 per cent. | 14 per cent. | 18 per cent. | |
| 5–16 | 12.75 | 8 " | 12 " | 16 " | |
| 3–8 | 15.30 | 7 " | 10 " | 13 " | 17 per cent. |
| 7–16 | 17.85 | 6 " | 8 " | 10 " | 13 " |
| 1–2 | 20.40 | 5 " | 7 " | 9 " | 12 " |
| 9–16 | 22.95 | 4½ " | 6½ " | 8½ " | 11 " |
| 5–8 | 25.50 | 4 " | 6 " | 8 " | 10 " |
| Over 5–8 | ..... | 3½ " | 5 " | 6½ " | 9 " |

*Plates under ¼ inch in thickness.*

| Thickness Ordered. Inches. | Nominal Weights. Lbs per sq. ft. | Width of Plate. | | |
|---|---|---|---|---|
| | | Up to 50 ins. | 50 ins. and up to 70 ins. | Over 70 ins. |
| 1–8 up to 5–32 | 5.10 to 6.37 | 10 per cent. | 15 per cent. | 20 per cent. |
| 5–32 " 3–16 | 6.37 to 7.65 | 8½ " | 12½ " | 17 " |
| 3–16 " 1–4 | 7.65 to 10.20 | 7 " | 10 " | 15 " |

11. Each plate shall be distinctly stamped with its heat or slab number, and with the name of the manufacturer, grade, and lowest tensile strength specified. Each test specimen shall be distinctly stamped with the heat or slab number which it represents. **Branding.**

Rivet steel may be shipped in securely fastened bundles with the melt number stamped on a metal tag attached.

12. All finished material shall be free from injurious surface defects and laminations, and must have a workmanlike finish. **Finish.**

13. The inspector representing the purchaser shall have all reasonable facilities afforded to him by the manufacturer to satisfy him that the finished material is furnished in accordance with these specifications. All tests and inspections shall be made at the place of manufacture, prior to shipment. **Inspection.**

# AMERICAN SOCIETY FOR TESTING MATERIALS

PHILADELPHIA, PA., U. S. A.

AFFILIATED WITH THE

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## STANDARD SPECIFICATIONS FOR BESSEMER STEEL RAILS.

ADOPTED AUGUST 16, 1909.

**Process of Manufacture.**

1. (*a*) The entire process of manufacture and testing shall be in accordance with the best current practice, and special care shall be taken to conform to the following instructions:

(*b*) Ingots shall be kept in a vertical position in the pit heating furnaces until ready to be rolled or until the metal in the interior has time to solidify.

(*c*) No bled ingots shall be used.

(*d*) There shall be sheared from the end of the blooms formed from the top of the ingots not less than $x$ per cent.,* and if, from any cause, the steel does not then appear to be solid, the shearing shall continue until it does.

**Chemical Composition.**

2. Rails of the various weights per yard specified below shall conform to the following limits in chemical composition:

| | 50 to 60 lbs. Per cent. | 61 to 70 lbs. Per cent. | 71 to 80 lbs. Per cent. | 81 to 90 lbs. Per cent. | 91 to 100 lbs. Per cent. |
|---|---|---|---|---|---|
| Carbon | 0.35-0.45 | 0.35-0.45 | 0.40-0.50 | 0.43-0.53 | 0.45-0.55 |
| Phosphorus, not over | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| Silicon, not over | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 |
| Manganese | 0.70-1.00 | 0.70-1.00 | 0.75-1.05 | 0.80-1.10 | 0.84-1.14 |

*The percentage of minimum discard in any case to be subject to agreement, and it should be recognized that the higher this percentage the greater will be the cost.

3. The number of passes and speed of train shall be so regulated that on leaving the rolls at the final pass, the temperature of rails of sections 75 lbs. per yard and heavier will not exceed that which requires a shrinkage allowance at the hot saws of $6\frac{7}{16}$ ins. for a 33-ft. 75-lb. rail, with an increase of $\frac{1}{16}$ in. for each increase of 5 lbs. in the weight of the section. **Shrinkage.**

No artificial means of cooling the steel shall be used after the rails leave the rolls, nor shall they be held before sawing for the purpose of reducing their temperature.

4. One drop test may be made on a piece of rail not less than 4 ft. and not more than 6 ft. long, selected from each blow of steel. **Drop Test.**

The rails shall be placed head upward on the supports and the various sections shall be subjected to the following impact tests under a free falling weight:

| Weights of rail per yard. | Height of drop in feet. |
|---|---|
| 50 to 60 lbs. | 15 |
| 61 to 70 lbs. | 16 |
| 71 to 80 lbs. | 16 |
| 81 to 90 lbs. | 17 |
| 91 to 100 lbs. | 18 |

If any rail breaks when subjected to the drop test, two additional tests will be made of other rails from the same blow of steel, and if either of these latter tests fail, all the rails of the blow which they represent will be rejected; but if both of these additional test pieces meet the requirements all the rails of the blow which they represent will be accepted.

The drop-testing machine shall have a tup of 2,000 lbs. weight, the striking face of which shall have a radius of not more than 5 ins., and the test rail shall be placed head upward on solid supports 3 ft. apart. The anvil block shall weigh at least 20,000 lbs., and the supports shall be part of, or firmly secured to, the anvil. The report of the drop test shall state the atmospheric temperature at the time the test was made. The temperature of the test pieces, when tested, shall be not less than 60° F. or greater than 120° F. The testing shall proceed concurrently with the operation of the mill. **Drop-Testing Machine.**

5. Unless otherwise specified, the section of rail shall be the American standard, recommended by the American Society of **Weight and Section.**

Civil Engineers, and shall conform, as accurately as possible, to the templet furnished by the railroad company, consistent with Paragraph 6, relative to specified weight. A variation in height of $\frac{1}{64}$ in. less, or $\frac{1}{32}$ in. greater than the specified height, and $\frac{1}{16}$ in. in width will be permitted.

6. The weight of the rails will be maintained as nearly as possible, after complying with Paragraph 5, to that specified in the contract. A variation of one-half of 1 per cent. for an entire order will be allowed. Rails shall be accepted and paid for according to actual weights.

**Length.** 7. The standard length of rails shall be 30 or 33 feet. Ten per cent. of the entire order will be accepted in shorter lengths, varying by even feet down to 24 feet. A variation of $\frac{1}{4}$ in. in length from that specified will be allowed.

Both ends of all short-length No. 1 rails shall be painted green.

8. Circular holes for splice bolts shall be drilled in accordance with the specifications of the purchaser. The holes shall accurately conform to the drawing and dimensions furnished, and must be free from burrs.

**Finish.** 9. Care must be taken in hot-straightening the rails, and it must result in their being left in such a condition that they shall not vary throughout their entire length more than 5 ins. from a straight line in any direction when delivered to the cold-straightening presses. Those which vary beyond that amount, or have short kinks, shall be classed as second quality rails and be so stamped. The distance between supports of rails in the gagging press shall not be less than 42 ins. Rails shall be straight in line and surface when finished—the straightening being done while cold—smooth on head, sawed square at ends, variations to be not more than $\frac{1}{32}$ in., and, prior to shipment, shall have the burr occasioned by the saw cutting removed and the ends made clean. No. 1 rails shall be free from injurious defects and flaws of all kinds.

**Branding.** 10. The name of the maker, the weight of the rail, and the month and year of manufacture shall be rolled in raised letters on the side of the web, and the number of the heat shall be so stamped on each rail as not to be covered by the splice bars. For rails weighing 70 lbs. per yard or over, a letter shall be stamped on the side of the web to indicate the portion of the ingot from which the rail was rolled.

11. No. 2 rails will be accepted to at least 5 per cent. of the whole order. Rails that possess any injurious defects, or which for any other cause are not suitable for first quality, or No. 1 rails, shall be considered as No. 2 rails; provided, however, that rails which contain any physical defects which impair their strength shall be rejected. The ends of all No. 2 rails shall be painted white in order to distinguish them. Rails rejected under the drop test will not be accepted as No. 2 rails. **No. 2 Rails.**

12. The manufacturer shall furnish the inspector, daily, with carbon determinations of each blow, and a complete chemical analysis every 24 hours, representing the average of the other elements contained in the steel for each day and night turn. Analyses shall be made on drillings taken from small test ingots, the drillings being taken at a distance of not less than $\frac{1}{4}$ in. beneath the surface of said test ingots. On request of the inspector the manufacturer shall furnish drillings for check analysis. **Inspection.**

The inspector representing the purchaser shall have free entry to the works of the manufacturer at all times while his contract is being executed, and shall have all reasonable facilities afforded him by the manufacturer to satisfy him that the rails are being made in accordance with the terms of the contract. All tests and inspection shall be made at the place of manufacture prior to shipment, and shall be so conducted as not to unnecessarily interfere with the operation of the mill.

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## STANDARD SPECIFICATIONS FOR OPEN-HEARTH STEEL RAILS.

ADOPTED AUGUST 16, 1909.

**Process of Manufacture.**

1. (*a*) The entire process of manufacture and testing shall be in accordance with the best current practice, and special care shall be taken to conform to the following instructions:

(*b*) Ingots shall be kept in a vertical position in the pit heating furnaces until ready to be rolled or until the metal in the interior has time to solidify.

(*c*) No bled ingots shall be used.

(*d*) There shall be sheared from the end of the blooms formed from the top of the ingots not less than $x$ per cent.,* and if, from any cause, the steel does not then appear to be solid, the shearing shall continue until it does.

**Chemical Composition.**

2. Rails of the various weights per yard specified below shall conform to the following limits in chemical composition:

| | 50 to 60 lbs. Per cent. | 61 to 70 lbs. Per cent. | 71 to 80 lbs. Per cent. | 81 to 90 lbs. Per cent. | 91 to 100 lbs. Per cent. |
|---|---|---|---|---|---|
| Carbon | 0.46-0.59 | 0.46-0.59 | 0.52-0.65 | 0.59-0.72 | 0.62-0.75 |
| Phosphorus, not over | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 |
| Silicon, not over | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 |
| Manganese | 0.60-0.90 | 0.60-0.90 | 0.60-0.90 | 0.60-0.90 | 0.60-0.90 |

*The percentage of minimum discard in any case to be subject to agreement, and it should be recognized that the higher this percentage the greater will be the cost.

For each decrease of 0.003 per cent. in phosphorus down to 0.03 per cent. phosphorus, an increase of 0.01 per cent. carbon will be accepted.

3. The number of passes and speed of train shall be so regulated that on leaving the rolls at the final pass, the temperature of rails of sections 75 lbs. per yard and heavier will not exceed that which requires a shrinkage allowance at the hot saws of $6\frac{7}{16}$ ins. for a 33-ft. 75-lb. rail, with an increase of $\frac{1}{16}$ in. for each increase of 5 lbs. in the weight of the section. **Shrinkage.**

No artificial means of cooling the steel shall be used after the rails leave the rolls, nor shall they be held before sawing for the purpose of reducing their temperature.

4. One drop test may be made on a piece of rail not less than 4 ft. and not more than 6 ft. long, selected from each heat of steel. **Drop Test.**

The rails shall be placed head upward on the supports and the various sections shall be subjected to the following impact tests under a free falling weight:

| Weights of rail per yard. | Height of drop in feet. |
|---|---|
| 50 to 60 lbs. | 15 |
| 61 to 70 lbs. | 16 |
| 71 to 80 lbs. | 16 |
| 81 to 90 lbs. | 17 |
| 91 to 100 lbs. | 18 |

If any rail breaks when subjected to the drop test, two additional tests will be made of other rails from the same heat of steel, and if either of these latter tests fail, all the rails of the heat which they represent will be rejected; but if both of these additional test pieces meet the requirements all the rails of the heat which they represent will be accepted.

The drop-testing machine shall have a tup of 2,000 lbs. weight, the striking face of which shall have a radius of not more than 5 ins., and the test rail shall be placed head upward on solid supports 3 ft. apart. The anvil block shall weigh at least 20,000 lbs., and the supports shall be part of, or firmly secured to, the anvil. The report of the drop test shall state the atmospheric temperature at the time the test was made. The temperature of the test pieces, when tested, shall be not less than 60° F. or greater than 120° F. The testing shall proceed concurrently with the operation of the mill. **Drop-Testing Machine.**

**Weight and Section.** 5. Unless otherwise specified, the section of rail shall be the American standard, recommended by the American Society of Civil Engineers, and shall conform, as accurately as possible, to the templet furnished by the railroad company, consistent with Paragraph 6, relative to specified weight. A variation in height of $\frac{1}{64}$ in. less, or $\frac{1}{32}$ in. greater than the specified height, and $\frac{1}{16}$ in. in width will be permitted.

6. The weight of the rails will be maintained as nearly as possible, after complying with Paragraph 5, to that specified in the contract. A variation of one-half of 1 per cent. for an entire order will be allowed. Rails shall be accepted and paid for according to actual weights.

**Length.** 7. The standard length of rails shall be 30 or 33 feet. Ten per cent. of the entire order will be accepted in shorter lengths, varying by even feet down to 24 feet. A variation of $\frac{1}{4}$ in. in length from that specified will be allowed.

Both ends of all short-length No. 1 rails shall be painted green.

8. Circular holes for splice bolts shall be drilled in accordance with the specifications of the purchaser. The holes shall accurately conform to the drawing and dimensions furnished, and must be free from burrs.

**Finish.** 9. Care must be taken in hot-straightening the rails, and it must result in their being left in such a condition that they shall not vary throughout their entire length more than 5 ins. from a straight line in any direction when delivered to the cold-straightening presses. Those which vary beyond that amount, or have short kinks, shall be classed as second quality rails and be so stamped. The distance between supports of rails in the gagging press shall not be less than 42 ins. Rails shall be straight in line and surface when finished—the straightening being done while cold—smooth on head, sawed square at ends, variations to be not more than $\frac{1}{32}$ in., and, prior to shipment, shall have the burr occasioned by the saw cutting removed and the ends made clean. No. 1 rails shall be free from injurious defects and flaws of all kinds.

**Branding.** 10. The name of the maker, the weight of the rail, and the month and year of manufacture shall be rolled in raised letters on the side of the web, and the number of the heat and the letters O. H. (to designate the grade of steel) shall be so stamped on each

rail as not to be covered by the splice bars. For rails weighing 70 lbs. per yard or over, a letter shall be stamped on the side of the web to indicate the portion of the ingot from which the rail was rolled.

11. No. 2 rails will be accepted to at least 5 per cent. of the whole order. Rails that possess any injurious defects, or which for any other cause are not suitable for first quality, or No. 1 rails, shall be considered as No. 2 rails; provided, however, that rails which contain any physical defects which impair their strength shall be rejected. The ends of all No. 2 rails shall be painted white in order to distinguish them. Rails rejected under the drop test will not be accepted as No. 2 rails. **No. 2 Rails.**

12. The manufacturer shall furnish the inspector a chemical analysis of each heat of steel covering the elements specified. Analyses shall be made on drillings taken from small test ingots, the drillings being taken at a distance of not less than ¼ in. beneath the surface of said test ingots. On request of the inspector the manufacturer shall furnish drillings for check analysis. **Inspection.**

The inspector representing the purchaser shall have free entry to the works of the manufacturer at all times while his contract is being executed, and shall have all reasonable facilities afforded him by the manufacturer to satisfy him that the rails are being made in accordance with the terms of the contract. All tests and inspection shall be made at the place of manufacture prior to shipment, and shall be so conducted as not to unnecessarily interfere with the operation of the mill.

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## STANDARD SPECIFICATIONS FOR STEEL SPLICE BARS.

ADOPTED AUGUST 16, 1909.

**Process of Manufacture.** 1. Steel for splice bars may be made by the Bessemer or open-hearth process.

**Phosphorus Limit.** 2. The phosphorus in steel for splice bars shall not exceed 0.10 per cent.

**Tensile Tests.** 3. Splice bar steel shall conform to the following physical qualities:

| | |
|---|---|
| Tensile strength, pounds per square inch... | 54,000 to 64,000 |
| Yield point, pounds per square inch...... | ½ T. S. |
| Elongation, per cent. in eight inches shall not be less than.................... | 25 |

**Bending Tests.** 4. (*a*) A test specimen cut from the head of the splice bar shall bend 180° flat on itself without fracture on the outside of the bent portion.

(*b*) If preferred the bending tests may be made on an unpunched splice bar, which, if necessary, shall be first flattened, and shall then be bent 180° flat on itself without fracture on the outside of the bent portion.

**Test Specimen for Tensile Test.** 5. A test specimen of 8-inch gauged length, cut from the rolled splice bar, shall be used to determine the physical properties specified in Paragraph 3.

6. One tensile test specimen shall be taken from the rolled splice bars of each blow or melt, but in case this develops flaws, or breaks outside of the middle third of its gauged length, it may be discarded and another test specimen substituted therefor. **Number of Tensile Tests.**

7. One test specimen cut from the head of the splice bar shall be taken from a rolled bar of each blow or melt, or if preferred the bending test may be made on an unpunched splice bar, which, if necessary, shall be flattened before testing. The bending test may be made by pressure or by blows. **Test Specimen for Bending.**

8. For the purposes of these specifications, the yield point shall be determined by the careful observation of the drop of the beam or halt in the gauge of the testing machine. **Yield Point.**

9. In order to determine if the material conforms to the chemical limitations prescribed in Paragraph 2 herein, analysis shall be made of drillings taken from a small test ingot. **Sample for Chemical Analysis.**

10. All splice bars shall be smoothly rolled and true to templet. The bars shall be sheared accurately to length and free from fins or cracks, and shall perfectly fit the rails for which they are intended. The punching and notching shall accurately conform in every respect to the drawing and dimensions furnished. **Finish.**

11. The name of the maker and the year of manufacture shall be rolled in raised letters on the side of the splice bar. **Branding.**

12. The inspector representing the purchaser shall have all reasonable facilities afforded to him by the manufacturer to satisfy him that the finished material is furnished in accordance with these specifications. All tests and inspections shall be made at the place of manufacture, prior to shipment. **Inspection.**

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# STANDARD SPECIFICATIONS FOR STEEL AXLES.

ADOPTED SEPTEMBER 1, 1905.

**Manufacture.** 1. Steel for axles shall be made by the open-hearth process.

**Chemical Properties.** 2. There will be three classes of steel axles which shall conform to the following limits in chemical composition.

| | Car and Tender Truck Axles. Per cent. | Driving and Engine Truck Axles. (Carbon Steel.) Per cent. | Driving and Engine Truck Axles. (Nickel Steel.) Per cent. |
|---|---|---|---|
| Phosphorus shall not exceed | 0.06 | 0.06 | 0.04 |
| Sulphur " " " | 0.06 | 0.06 | 0.04 |
| Manganese " " " | .... | 0.60 | .... |
| Nickel .................... | .... | .... | 3.0 to 4.0 |

**Physical Properties.** 3. For car and tender truck axles no tensile test shall be required.

4. The minimum physical qualities required in the two classes of driving and engine truck axles shall be as follows:

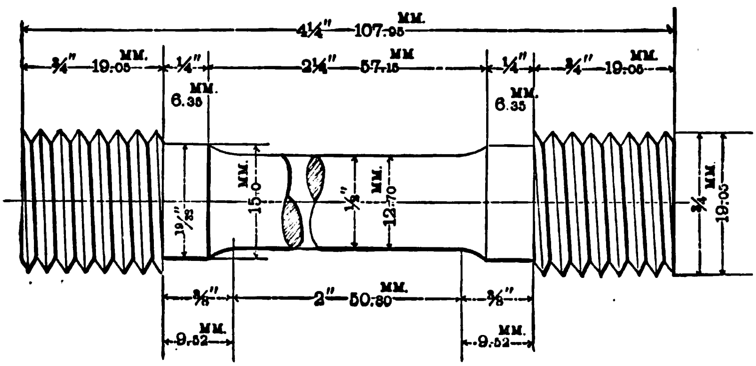
| | Driving and Engine Truck Axles. (Carbon Steel.) | Driving and Engine Truck Axles. (Nickel Steel.) |
|---|---|---|
| Tensile strength, pounds per square inch.. | 80,000 | 80,000 |
| Yield point, pounds per square inch ..... | 40,000 | 50,000 |
| Elongation, per cent. in two inches ...... | 20 | 25 |
| Contraction of area, per cent. ............ | 25 | 45 |

5. One axle selected from each melt, when tested by the drop test described in Paragraph 9, shall stand the number of blows at the height specified in the following table without rupture and without exceeding, as the result of the first blow, the deflection given. Any melt failing to meet these requirements will be rejected. **Drop Test.**

| Diameter of Axle at Center. Inches. | Number of Blows. | Height of Drop. Feet. | Deflection. Inches. |
|---|---|---|---|
| 4¼ | 5 | 24 | 8¼ |
| 4⅜ | 5 | 26 | 8¼ |
| 4 7/16 | 5 | 28½ | 8¼ |
| 4⅝ | 5 | 31 | 8 |
| 4¾ | 5 | 34 | 8 |
| 5⅜ | 5 | 43 | 7 |
| 5⅞ | 7 | 43 | 5½ |

6. Carbon steel and nickel steel driving and engine truck axles shall not be subject to the above drop test.

7. The standard test specimen one-half (½) inch diameter and two (2) inches gauged length, shall be used to determine the physical properties specified in Paragraph 4. It is shown in the following sketch: **Test Pieces and Methods of Testing.**




8. For driving and engine truck axles one longitudinal test specimen shall be cut from one axle of each melt. The center of this test specimen shall be half-way between the center and outside of the axle. **Number and Location of Tensile Specimens.**

**Drop Test Described.** 9. The points of supports on which the axle rests during tests must be three feet apart from center to center; the tup must weigh 1,640 pounds; the anvil, which is supported on springs, must weigh 17,500 pounds; it must be free to move in a vertical direction; the springs upon which it rests must be twelve in number, and the radius of supports and of the striking face on the tup in the direction of the axis of the axle must be five (5) inches. When an axle is tested it must be so placed in the machine that the tup will strike it midway between the ends, and it must be turned over after the first and third blows, and when required, after the fifth blow. To measure the deflection after the first blow prepare a straight edge as long as the axle, by reinforcing it on one side, equally at each end, so that when it is laid on the axle, the reinforced parts will rest on the collars or ends of the axle, and the balance of the straight edge not touch the axle at any place. Next place the axle in position for test, lay the straight edge on it, and measure the distance from the straight edge to the axle at the middle point of the latter. Then after the first blow, place the straight edge on the now bent axle in the same manner as before, and measure the distance from it to that side of the axle next to the straight edge at the point farthest away from the latter. The difference between the two measurements is the deflection. The report of the drop test shall state the atmospheric temperature at the time the tests were made.

**Yield Point.** 10. The yield point specified in Paragraph 4 shall be determined by the careful observation of the drop of the beam, or halt in the gauge of the testing machine.

**Sample for Chemical Analysis.** 11. Turnings from the tensile test specimen of driving and engine truck axles, or drillings taken midway between the center and outside of car, and tender truck axles, or drillings from the small test ingot, if preferred by the inspector, shall be used to determine whether the melt is within the limits of chemical composition specified in Paragraph 2.

**Finish.** 12. Axles shall conform in sizes, shapes and limiting weights to the requirements given on the order or print sent with it. They shall be made and finished in a workmanlike manner, and shall be free from all injurious cracks, seams or flaws. In centering, sixty (60) degree centers must be used, with clearance given at the point to avoid dulling the shop lathe centers.

13. Each axle shall be legibly stamped with the melt number and initials of the maker at the places marked on the print or indicated by the inspector. **Branding.**

14. The inspector representing the purchaser, shall have all reasonable facilities afforded to him by the manufacturer to satisfy him that the finished material is furnished in accordance with these specifications. All tests and inspections shall be made at the place of manufacture, prior to shipment. **Inspection.**

AMERICAN SOCIETY FOR TESTING MATERIALS

PHILADELPHIA, PA., U. S. A.

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# STANDARD SPECIFICATIONS FOR STEEL TIRES.

ADOPTED AUGUST 16, 1909.

**Material.** 1. Steel for tires shall be made by the open-hearth process.

**Classes.** 2. There will be three classes of tires for the different classes of service as follows:

(*a*) Driving tires for passenger engines.

(*b*) Driving tires for freight engines and tires for engine-truck, tender-truck, trailer and car wheels.

(*c*) Driving tires for switching engines.

**Chemical Composition.** 3. The steel for the three classes of service shall conform to the following limits in chemical composition:

| | | |
|---|---|---|
| Manganese shall not exceed .......... | 0.75 | per cent. |
| Silicon shall not exceed .............. | 0.35 | " " |
| Phosphorus shall not exceed ......... | 0.05 | " " |
| Sulphur shall not exceed ............ | 0.05 | " " |

**Samples for Chemical Analyses.** 4. Drillings from a small test ingot cast with the heat or turnings from a tensile specimen or turnings from a tire (where tires are machined at the works of the manufacturer) shall be used to determine whether the chemical composition of the heat is within the limits specified in Paragraph 3.

When samples for chemical analyses are taken from the finished material, a variation of 25 per cent. excess in phosphorus and sulphur over the limits specified in Paragraph 3 will be allowed.

**Analyses Furnished.**

5. When required, the purchaser or his representative shall be furnished an analysis of each heat from which tires are made.

**Physical Properties.**

6. The steel for the different classes of service shall meet the following minimum physical requirements:

| Class. | Tensile strength, lbs. per sq. in. | Elongation, per cent. in 2 ins. | Reduction of area, per cent. |
|---|---|---|---|
| (*a*)........ | 105,000 | 12 | 16 |
| (*b*)........ | 115,000 | 10 | 14 |
| (*c*)........ | 125,000 | 8 | 12 |

**Samples for Physical Tests.**

7. Samples for physical tests shall be taken from a test bar from an ingot of each heat represented, the ingot to be of such size as to give as nearly as practicable the same amount of work on the test bar as on the tire.

**Specimen for Tensile Tests.**

8. The standard turned test specimen, as shown by Fig. 1, ½ in. in diameter and 2 ins. gauge length, shall be used to determine the physical properties as specified in Paragraph 6.

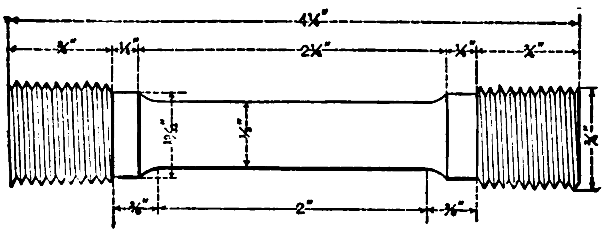


FIG. 1.

**Falling-weight Test.**

9. Should the contract call for a falling-weight test, a test tire from each heat represented shall be selected by the purchaser or his representative, and furnished at his expense provided it meets the requirements.

9a. The test tire shall be placed vertically under the drop in a running position on a solid foundation with an anvil of at least ten tons weight and shall be subjected to successive blows from a tup weighing 2,240 lbs., falling from heights of 10 ft., 15 ft. and 20 ft. and upwards, until the required deflection is obtained as specified in Paragraph 9b.

9b. The test tire shall stand the drop test described in Paragraph 9a. without breaking or cracking and shall show a minimum deflection equal to $D^2 \div (40T^2 + 2D)$, $D$ being the

internal diameter in inches and $T$ the thickness of the tire at center of tread.

9c. When requested, a specimen for the tensile test is to be taken from a tire that has been subjected to a falling-weight test, and it shall be cut cold from the tested tire at the point least affected by the falling-weight test. The tensile test specimen, when cut from a tire that has been subjected to a falling-weight test, shall be cut normal to the radius and parallel to the face.

9d. Should the test tire fail to meet the requirements in any particular, two more test tires shall be selected from the same heat if the manufacturer so desires, and at his expense. Should these two tires fulfill the requirements, the heat shall be accepted.

**Finish** 10. Tires must be free from cracks, flaws, seams, or other injurious imperfections. Tires developing such defects while being finished shall be returned to the manufacturer at his expense and replaced free of charge.

Tires (when furnished in the rough) shall conform to drawings with the following tolerances:

(*a*) *Height of Flange.*—The height of flange shall not be more than $\frac{3}{32}$ in. over or under the height called for.

(*b*) *Width of Flange.*—The width of flange shall not be more than $\frac{1}{16}$ in. over or under the dimensions called for.

(*c*) *Throat Radius.*—The throat radius shall not be more than $\frac{1}{8}$ in. greater nor more than $\frac{1}{16}$ in. less than the radius called for.

(*d*) *Width of Tire.*—The width of tire shall not be more than $\frac{1}{8}$ in. greater nor more than $\frac{1}{16}$ in. less than the width called for.

(*e*) *Inside Diameter.*—The diameter shall not be less than the diameter of the finished tire by more than $\frac{3}{8}$ in.

(*f*) *Outside Diameter.*—Tires 33 ins. or less in inside diameter shall be furnished in sets not varying more than $\frac{1}{16}$ in. in outside diameters and not out of round more than $\frac{1}{16}$ in.

Tires over 33 ins. in inside diameter shall be furnished in sets not varying more than $\frac{3}{32}$ in. in outside diameter and not out of round more than $\frac{3}{32}$ in.

**Branding.** 11. The manufacturer's brand and serial number shall be

stamped on the tire close to the inside edge where the stamping will not be cut off at the last turning. Set numbers shall be stenciled on each tire.

12. The inspector representing the purchaser shall have free entry to the works of the manufacturer at all times while his contract is being executed. All reasonable facilities shall be afforded to the inspector by the manufacturer to satisfy him that the tires are being furnished in accordance with the specifications. All tests and inspection shall be made at the place of manufacture prior to shipment and shall be so conducted as not to interfere unnecessarily with the operation of the mill. **Inspection.**

# AMERICAN SOCIETY FOR TESTING MATERIALS

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## STANDARD SPECIFICATIONS FOR STEEL FORGINGS.

ADOPTED SEPTEMBER 1, 1905.

**Manufacture.** 1. Steel for forgings may be made by the open-hearth, crucible or Bessemer process.

**Chemical Properties.** 2. There will be four classes of steel forgings which shall conform to the following limits in chemical composition.

| | Forgings of Soft or Low Carbon Steel. Per cent. | Forgings of Carbon Steel not Annealed. Per cent. | Forgings of Carbon Steel, Oil Tempered or Annealed. Per cent. | Locomotive Forgings. Per cent. | Forgings of Nickel Steel, Oil Tempered or Annealed. Per cent. |
|---|---|---|---|---|---|
| Phosphorus shall not exceed.. | 0.10 | 0.06 | 0.04 | 0.05 | 0.04 |
| Sulphur " " " .. | 0.10 | 0.06 | 0.04 | 0.05 | 0.04 |
| Manganese " " " .. | .... | .... | .... | 0.60 | .... |
| Nickel.................... | .... | .... | .... | .... | 3.0 to 4.0 |

**Physical Properties.** 3. The minimum physical qualities required of the different sized forgings of each class shall be as follows:

| | Tensile Strength. | Yield Point. | Elongation in 2 in. | Contraction of Area. |
|---|---|---|---|---|
| | Pounds per square inch. | | Per cent. | |
| SOFT STEEL OR LOW CARBON STEEL. | | | | |
| For solid or hollow forgings, no diameter or thickness of section to exceed 10 in......... | 58,000 | 29,000 | 28 | 35 |
| CARBON STEEL NOT ANNEALED. | | | | |
| For solid or hollow forgings, no diameter or thickness of section to exceed 10 in. ........ | 75,000 | 37,500 | 18 | 30 |

| | Tensile Strength. | Elastic Limit. | Elongation in 2 in. | Contraction of Area. |
|---|---|---|---|---|
| | Pounds per square inch. | | Per cent. | |
| CARBON STEEL ANNEALED. | | | | |
| For solid or hollow forgings, no diameter or thickness of section to exceed 10 in. ........ | 80,000 | 40,000 | 22 | 35 |
| For solid forgings, no diameter to exceed 20 in. or thickness of section 15 in. ............... | 75,000 | 37,500 | 23 | 35 |
| For solid forgings, over 20 in. diameter........ | 70,000 | 35,000 | 24 | 30 |
| CARBON STEEL, OIL TEMPERED. | | | | |
| For solid or hollow forgings, no diameter or thickness of section to exceed 3 in. ......... | 90,000 | 55,000 | 20 | 45 |
| CARBON STEEL, OIL TEMPERED. | | | | |
| For solid forgings of rectangular sections not exceeding 6 in. in thickness or hollow forgings, the walls of which do not exceed 6 in. in thickness.................................. | 85,000 | 50,000 | 22 | 45 |
| For solid forgings of rectangular sections not exceeding 10 in. in thickness or hollow forgings, the walls of which do not exceed 10 in. in thickness .................................. | 80,000 | 45,000 | 23 | 40 |
| LOCOMOTIVE FORGINGS. | 80,000 | 40,000 | 20 | 25 |
| NICKEL STEEL ANNEALED. | | | | |
| For solid or hollow forgings, no diameter or thickness of section to exceed 10 in. ........ | 80,000 | 50,000 | 25 | 45 |
| For solid forgings, no diameter to exceed 20 in. or thickness of section 15 in. ............... | 80,000 | 45,000 | 25 | 45 |
| For solid forgings, over 20 in. diameter........ | 80,000 | 45,000 | 24 | 40 |
| NICKEL STEEL, OIL TEMPERED. | | | | |
| For solid or hollow forgings, no diameter or thickness of section to exceed 3 in. ......... | 95,000 | 65,000 | 21 | 50 |
| For solid forgings of rectangular sections not exceeding 6 in. in thickness or hollow forgings, the walls of which do not exceed 6 in. in thickness .................................. | 90,000 | 60,000 | 22 | 50 |
| For solid forgings of rectangular sections not exceeding 10 in. in thickness or hollow forgings, the walls of which do not exceed 10 in. in thickness .................................. | 85,000 | 55,000 | 24 | 45 |

4. A specimen one inch by one-half inch (1 in. x ½ in.) shall bend cold 180° without fracture on outside of bent portion, as follows: **Bending Test**

Around a diameter of ½ in., for forgings of soft steel,

Around a diameter of 1½ in., for forgings of carbon steel not annealed,

Around a diameter of 1½ in., for forgings of carbon steel annealed, if 20 in. in diameter or over,

Around a diameter of 1 in., for forgings of carbon steel annealed, if under 20 in. diameter,

Around a diameter of 1 in. for forgings of carbon steel oil-tempered,

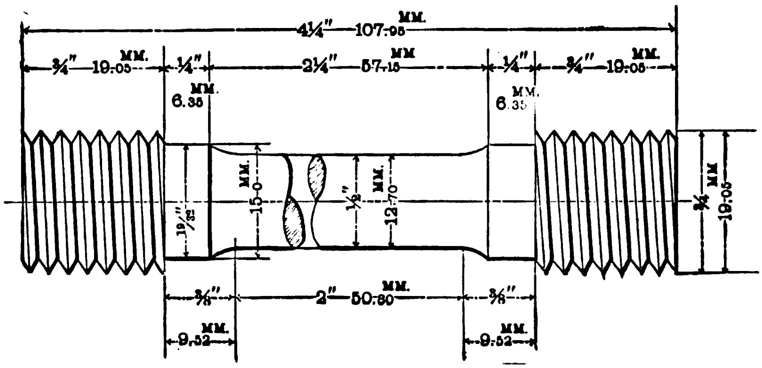
Around a diameter of ½ in., for forgings of nickel steel annealed,

Around a diameter of 1 in., for forgings of nickel steel oil-tempered.

For locomotive forgings no bending test required.

**Test Pieces and Methods of Testing.**

5. The standard turned test specimen, one-half inch (½ in.) diameter and two inch (2 in.) gauged length, shall be used to deter-




mine the physical properties specified in Paragraph 3. It is shown in the above sketch.

**Number and Location of Tensile Specimens.**

6. The number and location of test specimens to be taken from a melt, blow, or a forging shall depend upon its character and importance and must therefore be regulated by individual cases. The test specimens shall be cut cold from the forging or full-sized prolongation of same parallel to the axis of the forging and half-way between the center and outside, the specimens to be longitudinal, i. e., the length of the specimen to correspond with the direction in which the metal is most drawn out or worked. When forgings have large ends or collars, the test specimens shall be taken from a prolongation of the same diameter or section as that of the forging back of the large end or collar. In the case of hollow

shafting, either forged or bored, the specimen shall be taken within the finished section prolonged, half-way between the inner and outer surface of the wall of the forging.

7. The specimen for bending test one inch by one-half inch (1 in. x ½ in.) shall be cut as specified in Paragraph 6. The bending test may be made by pressure or by blows. **Test Specimen for Bending.**

8. The yield point specified in Paragraph 3 shall be determined by the careful observation of the drop of the beam, or halt in the gauge of the testing machine. **Yield Point.**

9. The elastic limit specified in Paragraph 3 shall be determined by means of an extensometer, which is to be attached to the test specimen in such manner as to show the change in rate of extension under uniform rate of loading, and will be taken at that point where the proportionality changes. **Elastic Limit.**

10. Turnings from the tensile specimen or drillings from the bending specimen or drillings from the small test ingot, if preferred by the inspector, shall be used to determine whether or not the steel is within the limits in chemical composition specified in Paragraph 2. **Sample for Chemical Analysis.**

11. Forging shall be free from cracks, flaws, seams or other injurious imperfections, and shall conform to dimensions shown on drawings furnished by the purchaser, and be made and finished in a workmanlike manner. **Finish.**

12. The inspector representing the purchaser shall have all reasonable facilities afforded to him by the manufacturer to satisfy him that the finished material is furnished in accordance with these specifications. All tests and inspections shall be made at the place of manufacture, prior to shipment. **Inspection.**

# AMERICAN SOCIETY FOR TESTING MATERIALS

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## STANDARD SPECIFICATIONS FOR STEEL CASTINGS.

ADOPTED SEPTEMBER 1, 1905.

**Process of Manufacture.** 1. Steel for castings may be made by the open-hearth, crucible or Bessemer process. Castings to be annealed unless otherwise specified.

**Chemical Properties.** 2. Ordinary castings, those in which no physical requirements are specified, shall not contain over 0.40 per cent. of carbon, nor over 0.08 per cent. of phosphorus.

3. Castings which are subjected to physical test shall not contain over 0.05 per cent. of phosphorus, nor over 0.05 per cent. of sulphur.

**Tensile Tests.** 4. Tested castings shall be of three classes: "HARD," "MEDIUM," and "SOFT." The minimum physical qualities required in each class shall be as follows:

| | Hard castings. | Medium castings. | Soft castings. |
|---|---|---|---|
| Tensile strength, pounds per square inch | 85,000 | 70,000 | 60,000 |
| Yield point, pounds per square inch.... | 38,250 | 31,500 | 27,000 |
| Elongation, per cent. in two inches.... | 15 | 18 | 22 |
| Contraction of area, per cent......... | 20 | 25 | 30 |

**Drop Test.** 5. A test to destruction may be substituted for the tensile test, in the case of small or unimportant castings, by selecting three castings from a lot. This test shall show the material to be ductile and free from injurious defects, and suitable for the purposes intended. A lot shall consist of all castings from the same melt or blow, annealed in the same furnace charge.

**Percussive Test.** 6. Large castings are to be suspended and hammered all over.

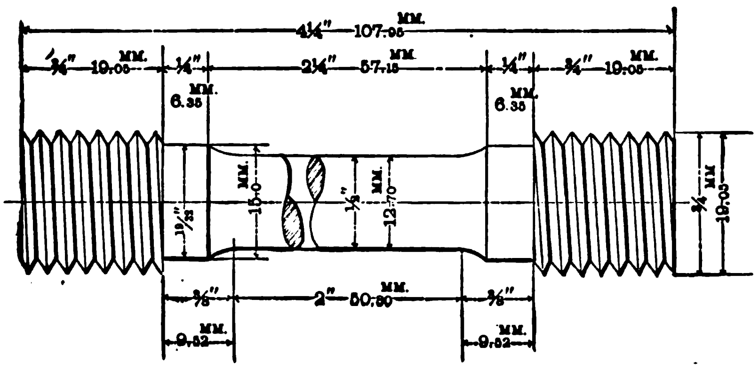
No cracks, flaws, defects, nor weakness shall appear after such treatment.

**Bending Test.**

7. A specimen one inch by one-half inch (1 in. x ½ in.) shall bend cold around a diameter of one inch (1 in.) without fracture on outside of bent portion, through an angle of 120° for "SOFT" castings, of 90° for "MEDIUM" castings.

**Test Piece for Tensile Test.**

8. The standard turned test specimen, one-half inch (½ in.) in diameter and two inch (2 in.) gauged length shall be used to determine the physical properties specified in Paragraph 4. It is shown in the following sketch:




**Number and Location of Specimens.**

9. The number of standard test specimens shall depend upon the character and importance of the castings. A test piece shall be cut cold from a coupon to be molded and cast on some portion of one or more castings from each melt or blow or from the sink-heads (in case heads of sufficient size are used). The coupon or sink-head must receive the same treatment as the casting or castings, before the specimen is cut out, and before the coupon or sink-head is removed from the casting.

**Test Piece for Bending.**

10. One specimen for bending test one inch by one-half inch (1 in. x ½ in.) shall be cut cold from the coupon or sink-head of the casting or castings as specified in Paragraph 9. The bending test may be made by pressure, or by blows.

**Yield Point.**

11. The yield point specified in Paragraph 4 shall be determined by the careful observation of the drop of the beam or halt in the gauge of the testing machine.

**Sample for Chemical Analysis.** 12. Turnings from the tensile specimen, drillings from the bending specimen, or drillings from the small test ingot, if preferred by the inspector, shall be used to determine whether or not the steel is within the limits in phosphorus and sulphur specified in Paragraphs 2 and 3.

**Finish.** 13. Castings shall be true to pattern, free from blemishes, flaws or shrinkage cracks. Bearing surfaces shall be solid, and no porosity shall be allowed in positions where the resistance and value of the casting for the purpose intended, will be seriously affected thereby.

**Inspection.** 14. The inspector representing the purchaser, shall have all reasonable facilities afforded to him by the manufacturer to satisfy him that the finished material is furnished in accordance with these specifications. All tests and inspections shall be made at the place of manufacture, prior to shipment.

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# STANDARD SPECIFICATIONS FOR WROUGHT IRON.

ADOPTED AUGUST 10, 1901.

**Manufacture.** 1. Wrought iron shall be made by the puddling or by the charcoal hearth process or rolled from fagots or piles made from wrought-iron scrap, alone or with muck bar added.

**Tensile Test.** 2. The minimum physical qualities required in the four classes of wrought iron shall be as follows:

| Properties Considered. | Staybolt iron. | Merchant iron. Grade A. | Merchant iron. Grade B. | Merchant iron. Grade C. |
|---|---|---|---|---|
| Tensile strength, pounds per sq. in. | 46,000 | 50,000 | 48,000 | 48,000 |
| Yield point, pounds per sq. in..... | 25,000 | 25,000 | 25,000 | 25,000 |
| Elongation, per cent. in 8 ins..... | 28 | 25 | 20 | 20 |

3. In sections weighing less than 0.654 pound per lineal foot, the percentage of elongation required in the four classes specified in Paragraph 2 shall be 21 per cent., 18 per cent., 15 per cent., and 12 per cent., respectively.

**Nicking Test.** 4. The four classes of iron when nicked and tested as described in Paragraph 9 shall show the following fracture:

(*a*) Staybolt iron: a long, clean, silky fiber, free from slag or dirt, and wholly fibrous, being practically free from crystalline spots.

(*b*) Merchant iron, Grade A: a long, clean, silky fiber, free

from slag or dirt or any coarse crystalline spots. A few fine crystalline spots may be tolerated, provided they do not in the aggregate exceed 10 per cent. of the sectional area of the bar.

(*c*) Merchant iron, Grade B: a generally fibrous fracture, free from coarse crystalline spots. Not over 10 per cent. of the fractured surface shall be granular.

(*d*) Merchant iron, Grade C: a generally fibrous fracture, free from coarse crystalline spots. Not over 15 per cent. of the fractured surface shall be granular.

**Cold Bending Test.** 5. The four classes of iron, when tested as described in Paragraph 10, shall conform to the following cold bending tests:

(*e*) Staybolt iron: A piece of staybolt iron about 24 inches long shall bend in the middle through 180° flat on itself, and then bend in the middle through 180° flat on itself in a plane at a right angle to the former direction, without a fracture on the outside of the bent portions. Another specimen with a thread cut over the entire length shall stand this double bending without showing deep cracks in the threads.

(*f*) Merchant iron, Grade A, shall bend cold 180° flat on itself without fracture on the outside of the bent portion.

(*g*) Merchant iron, Grade B, shall bend cold 180° around a diameter equal to the thickness of the specimen tested, without fracture on the outside of the bent portion.

(*h*) Merchant iron, Grade C, shall bend cold 180° around a diameter equal to twice the thickness of the specimen tested, without fracture on the outside of the bent portion.

**Hot Bending Test.** 6. The four classes of iron, when tested as described in Paragraph 11, shall conform to the following hot bending tests:

(*i*) Staybolt iron shall bend through 180° flat on itself, without showing cracks or flaws. A similar specimen heated to a yellow heat and suddenly quenched in water between 80° and 90° F., shall bend, without hammering on the bend, 180° flat on itself without showing cracks or flaws.

(*j*) Merchant iron, Grade A, shall bend through 180° flat on itself, without showing cracks or flaws. A similar specimen heated to a yellow heat and suddenly quenched in water between 80° and 90° F., shall bend, without hammering on the bend, 180° flat on itself without showing cracks or flaws. A similar specimen heated to a bright red heat, shall be split at the end and each part

bent back through an angle of 180°. It will also be quenched and expanded by drifts until a round hole is formed whose diameter is not less than nine-tenths of the diameter of the rod or width of the bar. Any extension of the original split or indications of fracture, cracks, or flaws developed by the above tests will be sufficient cause for the rejection of the lot represented by that rod or bar.

(*k*) Merchant iron, Grade B, shall bend through 180° flat on itself, without showing cracks or flaws.

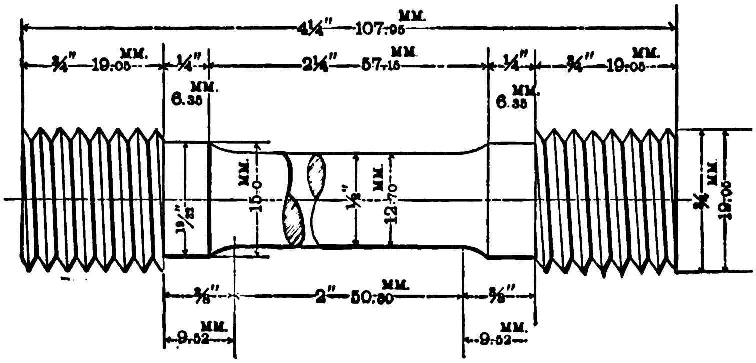
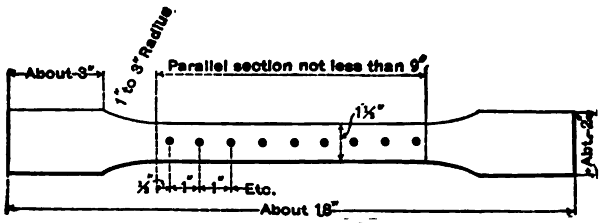



FIG. 1.




Piece to be of Same Thickness as the Plate.

FIG. 2.

(*l*) Merchant iron, Grade C, shall bend sharply to a right angle, without showing cracks or flaws.

**Threading Test.** 7. Staybolt iron shall permit of the cutting of a clean sharp thread and be rolled true to gauges desired, so as not to jam in the threading dies.

**Test Specimen for Tensile Test.** 8. Whenever possible, iron shall be tested in full size as rolled, to determine the physical qualities specified in Paragraphs 2 and 3, the elongation being measured on an 8-inch gauged length. In flats

and shapes too large to test as rolled, the standard test specimen shall be $1\frac{1}{2}$ inches wide and 8 inches gauged length.

In large rounds, the standard test specimen of 2 inches gauged length shall be used; the center of this specimen shall be half-way between the center and outside of the round. Sketches of these two standard test specimens are shown in Figs. 1 and 2.

**Nicking Tests.** 9. Nicking tests shall be made on specimens cut from the iron as rolled. The specimen shall be slightly and evenly nicked on one side and bent back at this point through an angle of 180° by a succession of light blows.

**Cold Bending Tests.** 10. Cold bending tests shall be made on specimens cut from the bar as rolled. The specimen shall be bent through an angle of 180° by pressure or by a succession of light blows.

**Hot Bending Tests.** 11. Hot bending tests shall be made on specimens cut from the bar as rolled. The specimens, heated to a bright red heat, shall be bent through an angle of 180° by pressure or by a succession of light blows and without hammering directly on the bend.

If desired, a similar bar of any of the four classes of iron shall be worked and welded in the ordinary manner without showing signs of red shortness.

**Yield Point.** 12. The yield point specified in Paragraph 2 shall be determined by the careful observation of the drop of the beam or halt in the gauge of the testing machine.

**Finish.** 13. All wrought iron must be practically straight, smooth, free from cinder spots or injurious flaws, buckles, blisters or cracks.

In round iron, sizes must conform to the Standard Limit gauge as adopted by the Master Car Builders' Association in November, 1883.

**Inspection.** 14. Inspectors representing the purchasers shall have all reasonable facilities afforded them by the manufacturer to satisfy them that the finished material is furnished in accordance with these specifications. All tests and inspections shall be made at the place of manufacture, prior to shipment.

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# STANDARD SPECIFICATIONS FOR FOUNDRY PIG IRON.*

ADOPTED AUGUST 16, 1909.

## PERCENTAGES AND VARIATIONS.

In order that there may be uniformity in grading, the following percentages and variations shall be used.†

| *Silicon.* Per cent. | Code. | *Sulphur.* Per cent. | Code. |
|---|---|---|---|
| 1.00 | La | 0.04 | Sa |
| 1.50 | Le | 0.05 | Se |
| 2.00 | Li | 0.06 | Si |
| 2.50 | Lo | 0.07 | So |
| 3.00 | Lu | 0.08 | Su |
| 3.50 | Ly | 0.09 | Sy |
| | | 0.10 | Sh |
| (0.25 allowed either way.) | | (Maximum.) | |

| *Total Carbon.* Per cent. | Code. | *Manganese.* Per cent. | Code. | *Phosphorus.* Per cent. | Code. |
|---|---|---|---|---|---|
| 3.00 | Ca | 0.20 | Ma | 0.20 | Pa |
| 3.20 | Ce | 0.40 | Me | 0.40 | Pe |
| 3.40 | Ci | 0.60 | Mi | 0.60 | Pi |
| 3.60 | Co | 0.80 | Mo | 0.80 | Po |
| 3.80 | Cu | 1.00 | Mu | 1.00 | Pu |
| | | 1.25 | My | 1.25 | Py |
| | | 1.50 | Mh | 1.50 | Ph |
| (Minimum.) | | (0.20 allowed either way.) | | (0.15 allowed either way.) | |

* It is recommended that foundry pig iron be bought by analysis, and that when so bought these Standard Specifications be used.

† These specifications do not advise that all five elements be specified in all contracts for pig iron, but do recommend that when these elements are specified, the given percentages shall be used.

Illustration of the use of above coding: The word Li-se-ca-mo-pi indicates

| Sil. | Sul. | Carb. | Mang. | Phos. |
|---|---|---|---|---|
| 2.00 | 0.05 | 3.00 | 0.80 | 0.60 |

with variations as allowed.

Percentages of any element specified half way between the above shall be designated by the addition of the letter X to the next lower symbol.

*Example.*—PeX indicates Phosphorus 0.50, with "allowed" variations (0.15) up and down.

In the case of phosphorus and manganese, the percentages may be used as maximum or minimum figures, but unless so specified they will be considered to include the variations above given.

## SAMPLING AND ANALYSIS.

Each car load, or its equivalent, shall be considered as a unit in sampling.

One sample shall be taken to every four tons in the car, and shall be so chosen from different parts of the car as to represent as nearly as possible the average quality of the iron.

Drillings shall be taken so as to fairly represent the composition of the pig as cast.

An equal weight of the drillings from each pig shall be thoroughly mixed to make up the sample for analysis.

In case of dispute, the sampling and analysis shall be made by an independent chemist, mutually agreed upon, if practicable, at the time the contract is made.

It is recommended that the standard methods of the American Foundrymen's Association be used for analysis. Gravimetric methods shall be used for the analysis of sulphur, unless otherwise specified in the contract.

The cost of re-sampling and re-analysis shall be borne by the party in error.

## BASE OR QUOTING PRICE.

For market quotations, an iron of 2.00 per cent. in silicon (with variations of 0.25 either way) and 0.05 per cent. in sulphur (maximum) shall be taken as the base.

## THE AMERICAN FOUNDRYMEN'S ASSOCIATION SUGGESTS THE FOLLOWING CLAUSES FOR THE PURPOSE OF ADJUSTING DISPUTES BETWEEN BUYER AND SELLER.

*Base Table.*—The following table may be filled out, and may become a part of the contract. "B", or Base, represents the price agreed upon for a pig iron running 2.00 per cent. in silicon (with allowed variation of 0.25 either way) and under 0.05 per cent. in sulphur; "C" is a constant differential to be determined at the time the contract is made.

This table is for settling any differences which may arise in filling a contract, as explained under penalties and allowances, and may be used to regulate the price of a grade of pig iron which the purchaser desires, and the seller agrees, to substitute for the one originally specified.

Silicon percentages allow 0.25 variation either way. Sulphur percentages are maximum.

| *Sulphur, per cent.* | *Silicon, per cent.* 3.25 | 3.00 | 2.75 | 2.50 | 2.25 | 2.00 | 1.75 | 1.50 | 1.25 | 1.00 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.04.. | B+6C | B+5C | B+4C | B+3C | B+2C | B+1C | B | B−1C | B−2C | B−3C |
| 0.05.. | B+5C | B+4C | B+3C | B+2C | B+1C | B | B−1C | B−2C | B−3C | B−4C |
| 0.06.. | B+4C | B+3C | B+2C | B+1C | B | B−1C | B−2C | B−3C | B−4C | B−5C |
| 0.07.. | B+3C | B+2C | B+1C | B | B−1C | B−2C | B−3C | B−4C | B−5C | B−6C |
| 0.08.. | B+2C | B+1C | B | B−1C | B−2C | B−3C | B−4C | B−5C | B−6C | B−7C |
| 0.09.. | B+1C | B | B−1C | B−2C | B−3C | B−4C | B−5C | B−6C | B−7C | B−8C |
| 0.10.. | B | B−1C | B−2C | B−3C | B−4C | B−5C | B−6C | B−7C | B−8C | B−9C |

*Penalties.*—In case the iron, when delivered, does not conform to the specifications, the buyer shall have the option of either refusing the iron, or accepting it on the basis shown in the above table, which must be filled out at the time the contract is made.

*Allowances.*—In case the furnace cannot, for any good reason, deliver the iron as specified at the time delivery is due, the purchaser may at his option accept any other analysis which the furnace can deliver, the price to be determined by the base table above, which must be filled out at the time the contract is made.

# AMERICAN SOCIETY FOR TESTING MATERIALS

PHILADELPHIA, PA., U. S. A.

AFFILIATED WITH THE

INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.

# STANDARD SPECIFICATIONS FOR CAST-IRON PIPE AND SPECIAL CASTINGS.

ADOPTED NOVEMBER 15, 1904.

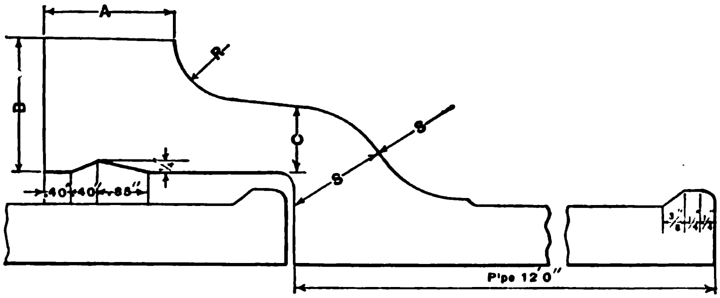
## DESCRIPTIONS OF PIPES.

SECTION 1. The pipes shall be made with hub and spigot joints, and shall accurately conform to the dimensions given in Tables I and II. They shall be straight and shall be true circles in section, with their inner and outer surfaces concentric, and shall be of the specified dimensions in outside diameter. They shall be at least 12 feet in length, exclusive of socket. For pipes of each size from 4-inch to 24-inch, inclusive, there shall be two standards of outside diameter, and for pipes from 30-inch to 60-inch, inclusive, there shall be four standards of outside diameter, as shown by Table II.

All pipes having the same outside diameter shall have the same inside diameter at both ends. The inside diameter of the lighter pipes of each standard outside diameter shall be gradually increased for a distance of about 6 inches from each end of the pipe so as to obtain the required standard thickness and weight for each size and class of pipe.

Pipes whose standard thickness and weight are intermediate between the classes in Table II shall be made of the same outside diameter as the next heavier class. Pipes whose standard thickness and weight are less than shown by Table II shall be

TABLE I.—GENERAL DIMENSIONS OF PIPES.




| Nominal Diam., ins. | Classes | Actual Outside Diam., ins. | DIAM. OF SOCKETS. Pipe, ins. | DIAM. OF SOCKETS. Special Castings, ins. | DEPTH OF SOCKETS. Pipe, ins. | DEPTH OF SOCKETS. Special Castings, ins. | A | B | C |
|---|---|---|---|---|---|---|---|---|---|
| 4 | A—B | 4.80 | 5.60 | 5.70 | 3.50 | 4.00 | 1.5 | 1.30 | 0.65 |
| 4 | C—D | 5.00 | 5.80 | 5.70 | 3.50 | 4.00 | 1.5 | 1.30 | 0.65 |
| 6 | A—B | 6.90 | 7.70 | 7.80 | 3.50 | 4.00 | 1.5 | 1.40 | 0.70 |
| 6 | C—D | 7.10 | 7.90 | 7.80 | 3.50 | 4.00 | 1.5 | 1.40 | 0.70 |
| 8 | | 9.05 | 9.85 | 10.00 | 4.00 | 4.00 | 1.5 | 1.50 | 0.75 |
| 8 | C—D | 9.30 | 10.10 | 10.00 | 4.00 | 4.00 | 1.5 | 1.50 | 0.75 |
| 10 | A—B | 11.10 | 11.90 | 12.10 | 4.00 | 4.00 | 1.5 | 1.50 | 0.75 |
| 10 | C—D | 11.40 | 12.20 | 12.10 | 4.00 | 4.00 | 1.5 | 1.60 | 0.80 |
| 12 | A—B | 13.20 | 14.00 | 14.20 | 4.00 | 4.00 | 1.5 | 1.60 | 0.80 |
| 12 | C—D | 13.50 | 14.30 | 14.20 | 4.00 | 4.00 | 1.5 | 1.70 | 0.85 |
| 14 | A—B | 15.30 | 16.10 | 16.10 | 4.00 | 4.00 | 1.5 | 1.70 | 0.85 |
| 14 | C—D | 15.65 | 16.45 | 16.45 | 4.00 | 4.00 | 1.5 | 1.80 | 0.90 |
| 16 | A—B | 17.40 | 18.40 | 18.40 | 4.00 | 4.00 | 1.75 | 1.80 | 0.90 |
| 16 | C— | 17.80 | 18.80 | 18.80 | 4.00 | 4.00 | 1.75 | 1.90 | 1.00 |
| 18 | A—B | 19.50 | 20.50 | 20.50 | 4.00 | 4.00 | 1.75 | 1.90 | 0.95 |
| 18 | C—D | 19.92 | 20.92 | 20.92 | 4.00 | 4.00 | 1.75 | 2.10 | 1.05 |
| 20 | A—B | 21.60 | 22.60 | 22.60 | 4.00 | 4.00 | 1.75 | 2.00 | 1.00 |
| 20 | C—D | 22.06 | 23.06 | 23.06 | 4.00 | 4.00 | 1.75 | 2.30 | 1.15 |
| 24 | A—B | 25.80 | 26.80 | 26.80 | 4.00 | 4.00 | 2.00 | 2.10 | 1.05 |
| 24 | C—D | 26.32 | 27.32 | 27.32 | 4.00 | 4.00 | 2.00 | 2.50 | 1.25 |
| 30 | A | 31.74 | 32.74 | 32.74 | 4.50 | 4.50 | 2.00 | 2.50 | 1.15 |
| 30 | B | 32.00 | 33.00 | 33.00 | 4.50 | 4.50 | 2.00 | 2.30 | 1.15 |
| 30 | C | 32.40 | 33.40 | 33.40 | 4.50 | 4.50 | 2.00 | 2.60 | 1.32 |
| 30 | D | 32.74 | 33.74 | 33.74 | 4.50 | 4.50 | 2.00 | 3.00 | 1.50 |
| 36 | A | 37.96 | 38.96 | 38.96 | 4.50 | 4.50 | 2.00 | 2.50 | 1.25 |
| 36 | B | 38.30 | 39.30 | 39.30 | 4.50 | 4.50 | 2.00 | 2.80 | 1.40 |
| 36 | C | 38.70 | 39.70 | 39.70 | 4.50 | 4.50 | 2.00 | 3.10 | 1.60 |
| 36 | D | 39.16 | 40.16 | 40.16 | 4.50 | 4.50 | 2.00 | 3.40 | 1.80 |
| 42 | A | 44.20 | 45.20 | 45.20 | 5.00 | 5.00 | 2.00 | 2.80 | 1.40 |
| 42 | B | 44.55 | 45.50 | 45.50 | 5.00 | 5.00 | 2.00 | 3.00 | 1.50 |
| 42 | C | 45.10 | 46.10 | 46.10 | 5.00 | 5.00 | 2.00 | 3.40 | 1.75 |
| 42 | D | 45.58 | 46.58 | 46.58 | 5.00 | 5.00 | 2.00 | 3.80 | 1.95 |
| 48 | A | 50.50 | 51.50 | 51.50 | 5.00 | 5.00 | 2.00 | 3.00 | 1.50 |

TABLE I.—(CONTINUED.)

| Nominal Diam., ins. | Classes. | Actual Outside Diam., ins. | Diam. of Sockets. | | Depth of Sockets. | | A | B | C |
|---|---|---|---|---|---|---|---|---|---|
| | | | Pipe, ins. | Special Castings, ins. | Pipe, ins. | Special Castings, ins. | | | |
| 48 | B | 50.80 | 51.80 | 51.80 | 5.00 | 5.00 | 2.00 | 3.30 | 1.65 |
| 48 | C | 51.40 | 52.40 | 52.40 | 5.00 | 5.00 | 2.00 | 3.80 | 1.95 |
| 48 | D | 51.98 | 52.98 | 52.98 | 5.00 | 5.00 | 2.00 | 4.20 | 2.20 |
| 54 | A | 56.66 | 57.66 | 57.66 | 5.50 | 5.50 | 2.25 | 3.20 | 1.60 |
| 54 | B | 57.10 | 58.10 | 58.10 | 5.50 | 5.50 | 2.25 | 3.60 | 1.80 |
| 54 | C | 57.80 | 58.80 | 58.80 | 5.50 | 5.50 | 2.25 | 4.00 | 2.15 |
| 54 | D | 58.40 | 59.40 | 59.40 | 5.50 | 5.50 | 2.25 | 4.40 | 2.45 |
| 60 | A | 62.80 | 63.80 | 63.80 | 5.50 | 5.50 | 2.25 | 3.40 | 1.70 |
| 60 | B | 63.40 | 64.40 | 64.40 | 5.50 | 5.50 | 2.25 | 3.70 | 1.90 |
| 60 | C | 64.20 | 65.20 | 65.20 | 5.50 | 5.50 | 2.25 | 4.20 | 2.25 |
| 60 | D | 64.82 | 65.82 | 65.82 | 5.50 | 5.50 | 2.25 | 4.70 | 2.60 |

made of the same outside diameter as the Class A pipes, and pipes whose thickness and weight are more than shown by Table II shall be made of the same outside diameter as the Class D pipes.

For pipes 4-inch to 12-inch, inclusive, one class of special castings shall be furnished, made from Class D pattern. Those having spigot ends shall have outside diameters of spigot ends midway between the two standards of outside diameter as shown by Table II, and shall be tapered back for a distance of 6 inches. For pipes from 14-inch to 24-inch, inclusive, two classes of special castings shall be furnished, Class B special castings with Classes A and B pipes, and Class D special castings with Classes C and D pipes, the former to be stamped "AB" and the latter to be stamped "CD." For pipes 30-inch to 60-inch, inclusive, four classes of special castings shall be furnished, one for each class of pipe, and shall be stamped with the letter of the class to which they belong.

## ALLOWABLE VARIATION IN DIAMETER OF PIPES AND SOCKETS.

SECTION 2. Especial care shall be taken to have the sockets of the required size. The sockets and spigots will be tested by circular gauges, and no pipe will be received which is defective in joint room from any cause. The diameters of the sockets and the outside diameters of the bead ends of the pipes shall not vary

TABLE II.—STANDARD THICKNESSES AND WEIGHTS OF CAST-IRON PIPE.

| Nominal Inside Diam., ins. | Class A. 100 ft. head. 43 lbs. pressure. | | | Class B. 200 ft. head. 86 lbs. pressure. | | | Class C. 300 ft. head. 130 lbs. pressure. | | | Class D. 400 ft. head. 173 lbs. pressure. | | | Nominal Inside Diam., ins. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Thickness, ins. | Weight per Foot. | Weight per Length. | Thickness, ins. | Weight per Foot. | Weight per Length. | Thickness, ins. | Weight per Foot. | Weight per Length. | Thickness, ins. | Weight per Foot. | Weight per Length. | |
| 4 | 0.42 | 20.0 | 240 | 0.45 | 21.7 | 260 | 0.48 | 23.3 | 280 | 0.52 | 25.0 | 300 | 4 |
| 6 | 0.44 | 30.8 | 370 | 0.48 | 33.3 | 400 | 0.51 | 35.8 | 430 | 0.55 | 38.3 | 460 | 6 |
| 8 | 0.46 | 42.9 | 515 | 0.51 | 47.5 | 570 | 0.56 | 52.1 | 625 | 0.60 | 55.8 | 670 | 8 |
| 10 | 0.50 | 57.1 | 685 | 0.57 | 63.8 | 765 | 0.62 | 70.8 | 850 | 0.68 | 76.7 | 920 | 10 |
| 12 | 0.54 | 72.5 | 870 | 0.62 | 82.1 | 985 | 0.68 | 91.7 | 1,100 | 0.75 | 100.0 | 1,200 | 12 |
| 14 | 0.57 | 89.6 | 1,075 | 0.66 | 102.5 | 1,230 | 0.74 | 116.7 | 1,400 | 0.82 | 129.2 | 1,550 | 14 |
| 16 | 0.60 | 108.3 | 1,300 | 0.70 | 125.0 | 1,500 | 0.80 | 143.8 | 1,725 | 0.89 | 158.3 | 1,900 | 16 |
| 18 | 0.64 | 129.2 | 1,550 | 0.75 | 150.0 | 1,800 | 0.87 | 175.0 | 2,100 | 0.96 | 191.7 | 2,300 | 18 |
| 20 | 0.67 | 150.0 | 1,800 | 0.80 | 175.0 | 2,100 | 0.92 | 208.3 | 2,500 | 1.03 | 229.2 | 2,750 | 20 |
| 24 | 0.76 | 204.2 | 2,450 | 0.89 | 233.3 | 2,800 | 1.04 | 279.2 | 3,350 | 1.16 | 306.7 | 3,680 | 24 |
| 30 | 0.88 | 291.7 | 3,500 | 1.03 | 333.3 | 4,000 | 1.20 | 400.0 | 4,800 | 1.37 | 450.0 | 5,400 | 30 |
| 36 | 0.99 | 391.7 | 4,700 | 1.15 | 454.2 | 5,450 | 1.36 | 545.8 | 6,550 | 1.58 | 625.0 | 7,500 | 36 |
| 42 | 1.10 | 512.5 | 6,150 | 1.28 | 591.7 | 7,100 | 1.54 | 716.7 | 8,600 | 1.78 | 825.0 | 9,900 | 42 |
| 48 | 1.26 | 666.7 | 8,000 | 1.42 | 750.0 | 9,000 | 1.71 | 908.3 | 10,900 | 1.96 | 1,050.0 | 12,600 | 48 |
| 54 | 1.35 | 800.0 | 9,600 | 1.55 | 933.3 | 1,200 | 1.90 | 1,141.7 | 13,700 | 2.23 | 1,341.7 | 16,100 | 54 |
| 60 | 1.39 | 916.7 | 11,000 | 1.67 | 1,104.2 | 13,250 | 2.00 | 1,341.7 | 16,100 | 2.38 | 1,583.3 | 19,000 | 60 |

The above weights are for 12 feet laying lengths and standard sockets; proportionate allowance to be made for any variation therefrom.

from the standard dimensions by more than 0.06 inch for pipes 16 inches or less in diameter; 0.08 inch for 18-inch, 20-inch and 24-inch pipes; 0.10 inch for 30-inch, 36-inch and 42-inch pipes; 0.12 inch for 48-inch pipes; and 0.15 inch for 54-inch and 60-inch pipes.

## ALLOWABLE VARIATION IN THICKNESS.

SECTION 3. For pipes whose standard thickness is less than 1 inch, the thickness of metal in the body of the pipe shall not be more than 0.08 inch less than the standard thickness; and for pipes whose standard thickness is 1 inch or more, the variation shall not exceed 0.10 inch, except that for spaces not exceeding 8 inches in length in any direction, variations from the standard thickness of 0.02 inch in excess of the allowance above given shall be permitted.

For special castings of standard patterns a variation of 50 per cent. greater than allowed for straight pipe shall be permitted.

## DEFECTIVE SPIGOTS MAY BE CUT.

SECTION 4. Defective spigot ends on pipes 12 inches or more in diameter may be cut off in a lathe, and a half-round wrought-iron band shrunk into a groove cut in the end of the pipe. Not more than 12 per cent. of the total number of accepted pipes of each size shall be cut and banded, and no pipe shall be banded which is less than 11 feet in length, exclusive of the socket.

In case the length of a pipe differs from 12 feet, the standard weight of the pipe given in Table II shall be modified in accordance therewith.

## SPECIAL CASTINGS.

SECTION 5. All special castings shall be made in accordance with the cuts and the dimensions given in the table forming a part of these specifications.

The diameters of the sockets and the external diameters of the bead ends of the special castings shall not vary from the standard dimensions by more than 0.12 inch for castings 16 inches or less in diameter; 0.15 inch for 18-inch, 20-inch and 24-inch pipes; 0.20 inch for 30-inch, 36-inch and 42-inch pipes; and 0.24 inch for 48-inch, 54-inch and 60-inch pipes. These variations apply only to special castings made from standard patterns.

The flanges on all manhole castings and manhole covers shall be faced true and smooth, and drilled to receive bolts of the sizes given in the tables. The manufacturer shall furnish and deliver all bolts for bolting on the manhole covers, the bolts to be of the sizes shown on plans and made of the best quality of mild steel, with hexagonal heads and nuts and sound, well-fitting threads.

## MARKING.

SECTION 6. Every pipe and special casting shall have distinctly cast upon it the initials of the maker's name. When cast especially to order, each pipe and special casting larger than 4-inch may also have cast upon it figures showing the year in which it was cast and a number signifying the order in point of time in which it was cast, the figures denoting the year being above and the number below, thus:

| | | |
|---|---|---|
| 1901 | 1901 | 1901 |
| 1 | 2 | 3 |

etc., also any initials, not exceeding four, which may be required by the purchaser. The letters and figures shall be cast on the outside and shall be not less than 2 inches in length and $\frac{1}{8}$ inch in relief for pipes 8 inches in diameter and larger. For smaller sizes of pipes the letters may be 1 inch in length. The weight and the class letter shall be conspicuously painted in white on the inside of each pipe and special casting after the coating has become hard.

## ALLOWABLE PERCENTAGE OF VARIATION IN WEIGHT.

SECTION 7. No pipe shall be accepted the weight of which shall be less than the standard weight by more than 5 per cent. for pipes 16 inches or less in diameter, and 4 per cent. for pipes more than 16 inches in diameter; and no excess above the standard weight of more than the given percentages for the several sizes shall be paid for. The total weight to be paid for shall not exceed for each size and class of pipe received the sum of the standard weights of the same number of pieces of the given size and class by more than 2 per cent.

No special casting shall be accepted the weight of which shall be less than the standard weight by more than 10 per cent. for pipes 12 inches or less in diameter, and 8 per cent. for larger sizes, except that curves, Y-pieces and breeches pipe may be 12 per cent. below the standard weight, and no excess above the standard weight of more than the above percentages for the several sizes will be paid for. These variations apply only to castings made from the standard patterns.

## QUALITY OF IRON.

SECTION 8. All pipes and special castings shall be made of cast iron of good quality, and of such character as shall make the metal of the castings strong, tough and of even grain, and soft enough to satisfactorily admit of drilling and cutting. The metal shall be made without any admixture of cinder iron or other inferior metal, and shall be remelted in a cupola or air furnace.

## TESTS OF MATERIALS.

SECTION 9. Specimen bars of the metal used, each being 26 inches long by 2 inches wide and 1 inch thick, shall be made without charge as often as the engineer may direct, and, in default of definite instructions, the contractor shall make and test at least one bar from each heat or run of metal. The bars, when placed flatwise upon supports 24 inches apart and loaded in the center, shall, for pipes 12 inches or less in diameter, support a load of 1,900 pounds and show a deflection of not less than 0.30 inch before breaking; and for pipes of sizes larger than 12 inches, they shall support a load of 2,000 pounds and show a deflection of not less than 0.32 inch. The contractor shall have the right to make and break three bars from each heat or run of metal, and the test shall be based upon the average results of the three bars. Should the dimensions of the bars differ from those above given, a proper allowance therefor shall be made in the results of the tests.

## CASTING OF PIPES.

SECTION 10. The straight pipes shall be cast in dry sand molds in a vertical position. Pipes 16 inches or less in diameter

shall be cast with the hub end up or down, as specified in the proposal. Pipes 18 inches or more in diameter shall be cast with the hub end down.

The pipes shall not be stripped or taken from the pit while showing color of heat, but shall be left in the flasks for a sufficient length of time to prevent unequal contraction by subsequent exposure.

### QUALITY OF CASTINGS.

SECTION 11. The pipes and special castings shall be smooth, free from scales, lumps, blisters, sand holes and defects of every nature which unfit them for the use for which they are intended. No plugging or filling will be allowed.

### CLEANING AND INSPECTION.

SECTION 12. All pipes and special castings shall be thoroughly cleaned and subjected to a careful hammer inspection. No casting shall be coated unless entirely clean and free from rust, and approved in these respects by the engineer immediately before being dipped.

### COATING.

SECTION 13. Every pipe and special casting shall be coated inside and out with coal-tar pitch varnish. The varnish shall be made from coal tar. To this material sufficient oil shall be added to make a smooth coating, tough and tenacious when cold, and not brittle nor with any tendency to scale off.

Each casting shall be heated to a temperature of 300° F. immediately before it is dipped, and shall possess not less than this temperature at the time it is put in the vat. The ovens in which the pipes are heated shall be so arranged that all portions of the pipe shall be heated to an even temperature. Each casting shall remain in the bath at least five minutes.

The varnish shall be heated to a temperature of 300° F. (or less if the engineer shall so order), and shall be maintained at this temperature during the time the casting is immersed.

Fresh pitch and oil shall be added when necessary to keep the mixture at the proper consistency, and the vat shall be emptied

of its contents and refilled with fresh pitch when deemed necessary by the engineer. After being coated, the pipes shall be carefully drained of the surplus varnish. Any pipe or special casting that is to be re-coated shall first be thoroughly scraped and cleaned.

## HYDROSTATIC TEST.

SECTION 14. When the coating has become hard, the straight pipes shall be subjected to a proof by hydrostatic pressure and, if required by the engineer, they shall also be subjected to a hammer test under this pressure.

The pressure to which the different sizes and classes of pipes shall be subjected are as follows:

| | 20-Inch Diameter and Larger, lbs. per sq. in. | Less than 20-Inch Diameter, lbs. per sq. in. |
|---|---|---|
| Class A pipe | 150 | 300 |
| Class B pipe | 200 | 300 |
| Class C pipe | 250 | 300 |
| Class D pipe | 300 | 300 |

## WEIGHING.

SECTION 15. The pipes and special castings shall be weighed for payment under the supervision of the engineer after the application of the coal-tar pitch varnish. If desired by the engineer the pipes and special castings shall be weighed after their delivery, and the weights so ascertained shall be used in the final settlement, provided such weighing is done by a legalized weighmaster. Bids shall be submitted and a final settlement made up on the basis of a ton of 2,000 pounds.

## CONTRACTOR TO FURNISH MEN AND MATERIALS.

SECTION 16. The contractor shall provide all tools, testing machines, materials and men necessary for the required testing, inspection and weighing at the foundry of the pipes and special castings; and, should the purchaser have no inspector at the works, the contractor shall, if required by the engineer, furnish a sworn

statement that all of the tests have been made as specified, this statement to contain the results of the tests upon the test bars.

### POWER OF ENGINEER TO INSPECT.

SECTION 17. The engineer shall be at liberty at all times to inspect the material at the foundry, and the molding, casting and coating of the pipes and special castings. The forms, sizes, uniformity and conditions of all pipes and other castings herein referred to shall be subject to his inspection and approval, and he may reject, without proving, any pipes or other casting which is not in conformity with the specifications or drawings.

### INSPECTOR TO REPORT.

SECTION 18. The inspector at the foundry shall report daily to the foundry office all pipes and special castings rejected, with the causes for rejection.

### CASTINGS TO BE DELIVERED SOUND AND PERFECT.

SECTION 19. All the pipes and other castings must be delivered in all respects sound and conformable to these specifications. The inspection shall not relieve the contractor of any of his obligations in this respect, and any defective pipe or other castings which may have passed the engineer at the works or elsewhere shall be at all times liable to rejection when discovered until the final completion and adjustment of the contract, provided, however, that the contractor shall not be held liable for pipes or special castings found to be cracked after they have been accepted at the agreed point of delivery. Care shall be taken in handling the pipes not to injure the coating, and no pipes or other material of any kind shall be placed in the pipes during transportation or at any time after they receive the coating.

### DEFINITION OF THE WORD "ENGINEER."

SECTION 20. Wherever the word "engineer" is used herein, it shall be understood to refer to the engineer or inspector acting for the purchaser and to his properly authorized agents, limited by the particular duties intrusted to them.

## AMERICAN SOCIETY FOR TESTING MATERIALS

PHILADELPHIA, PA., U. S. A.

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# STANDARD SPECIFICATIONS FOR LOCOMOTIVE CYLINDERS.

ADOPTED NOVEMBER 15, 1904.

**Process of Manufacture.**

1. Locomotive cylinders shall be made from good quality of close-grained gray iron cast in a dry sand mold.

**Chemical Properties.**

2. Drillings taken from test pieces cast as hereafter mentioned shall conform to the following limits in chemical composition:

| | | | |
|---|---|---|---|
| Silicon .................. | from 1.25 to | 1.75 | per cent. |
| Phosphorus .............. | not over | 0.9 | " |
| Sulphur .................. | " | 0.10 | " |

**Physical Properties.**

3. The minimum physical qualities for cylinder iron shall be as follows:

The "Arbitration Test Bar," 1¼ inches in diameter, with supports 12 inches apart, shall have a transverse strength not less than 3,000 pounds, centrally applied, and a deflection not less than 0.10 inch.

**Test Pieces and Method of Testing.**

4. The standard test piece shall be 1¼ inches in diameter, about 14 inches long, cast on end in dry sand. The drillings for analysis shall be taken from this test piece, but in case of rejection the manufacturer shall have option of analyzing drillings from the bore of the cylinder, upon which analysis the acceptance or rejection of the cylinder shall be based.

One test piece for each cylinder shall be required.

5. Castings shall be smooth, well cleaned, free from blowholes, shrinkage cracks or other defects, and must finish to blue-print size. **Character of Castings.**

Each cylinder shall have cast on each side of saddle, the manufacturer's mark, serial number, date made and mark showing order number.

6. The inspector representing the purchaser shall have all reasonable facilities afforded to him by the manufacturer to satisfy himself that the finished material is furnished in accordance with these specifications. All tests and inspections shall be made at the place of the manufacturer. **Inspection.**

# AMERICAN SOCIETY FOR TESTING MATERIALS

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INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.

## STANDARD SPECIFICATIONS FOR CAST-IRON CAR WHEELS.

ADOPTED SEPTEMBER 1, 1905.

**Chemical Properties.** The wheels furnished under this specification must be made from the best materials, and in accordance with the best foundry methods. The following pattern analysis is given for information, as representing the chemical properties of a good cast-iron wheel. Successful wheels, varying in some of the constituents quite considerably from the figures given, may be made:

| | | |
|---|---|---|
| Total carbon | 3.50 | per cent. |
| Graphitic carbon | 2.90 | " |
| Combined carbon | 0.60 | " |
| Silicon | 0.70 | " |
| Manganese | 0.40 | " |
| Phosphorus | 0.50 | " |
| Sulphur | 0.08 | " |

1. Wheels will be inspected and tested at the place of manufacture.

2. All wheels must conform in general design and in measurements to drawings, which will be furnished, and any departure from the standard drawing must be by special permission in writing, and manufacturers wishing to deviate from the standard dimensions must submit duplicate drawings showing the proposed changes, which must be approved.

**Drop Tests.** 3. The following table gives data as to weight and tests of various kinds of wheels for different kinds of cars and service:

| Wheel | | 33-inch diameter Frgt. and Pass. cars. | | | 36-inch diameter. | |
|---|---|---|---|---|---|---|
| Kind of service | | 60,000 lbs. capacity and less. | 70,000 lbs. capacity. | 100,000 lbs. capacity. | Passenger Cars. | Locomotive Tenders. |
| Number | | 1 | 2 | 3 | 4 | 5 |
| Weight | Desired | 600 | 650 | 700 | 700 lbs. | 750 lbs. |
| | Variation | Two per cent. either way. | | | | |
| Height of drop, ft. | | 9 | 12 | 12 | 12 | 12 |
| Number of blows | | 10 | 10 | 12 | 12 | 14 |

4. Each wheel must have plainly cast on the outside plate the name of the maker and place of manufacture. Each wheel must also have cast on the inside double plate the date of casting and a serial foundry number. The manufacturer must also provide for the guarantee mark, if so required by the contract. No wheel bearing a duplicate number, or a number which has once been passed upon, will be considered. Numbers of wheels once rejected will remain unfilled. No wheel bearing an indistinct number or date, or any evidence of an altered or defaced number will be considered. **Marking.**

5. All wheels offered for inspection must have been measured with a standard tape measure and must have the shrinkage number stenciled in plain figures on the inside of the wheel. The standard tape measure must correspond in form and construction to the "Wheel Circumference Measure" established by the Master Car Builders' Association in 1900. The nomenclature of that measure need not, however, be followed, it being sufficient if the graduating marks indicating tape sizes are one-eighth of an inch apart. Any convenient method of showing the shrinkage or stencil number may be employed. Experience shows that standard tape measures elongate a little with use, and it is essential to have them frequently compared and rectified. When ready for inspection, the wheels must be arranged in rows according to shrinkage numbers, all wheels of the same date being grouped together. Wheels bearing dates more than thirty days prior to the date of inspection will not be accepted for test, except by permission. For any single inspection and test only wheels having **Measures.**

three consecutive shrinkage or stencil numbers will be considered. The manufacturer will, of course, decide what three shrinkage or stencil numbers he will submit in any given lot of 103 wheels offered, and the same three shrinkage or stencil numbers need not be offered each time.

**Finish.** 6. The body of the wheels must be smooth and free from slag and blowholes, and the hubs must be solid. Wheels will not be rejected because of drawing around the center core. The tread and throat of the wheels must be smooth, free from deep and irregular wrinkles, slag, sand wash, chill cracks or swollen rims, and be free from any evidence of hollow rims, and the throat and thread must be practically free from sweat.

**Material and Chill.** 7. Wheels tested must show soft, clean, gray iron, free from defects, such as holes containing slag or dirt more than one-quarter of an inch in diameter, or clusters of such holes, honey-combing of iron in the hub, white iron in the plates or hub, or clear white iron around the anchors of chaplets at a greater distance than one-half of an inch in any direction. The depth of the clear white iron must not exceed seven-eighths of an inch at the throat and one inch at the middle of the tread, nor must it be less than three-eighths of an inch at the throat or any part of the tread. The blending of the white iron with the gray iron behind must be without any distinct line of demarcation, and the iron must not have a mottled appearance in any part of the wheel at a greater distance than one and five-eighths inches from the tread or throat. The depth of chill will be determined by inspection of the three test wheels described below, all test wheels being broken for this purpose, if necessary. If one only of the three test wheels fails in limits of chill, all the lot under test of the same shrinkage or stencil number will be rejected and the test will be regarded as finished so far as this lot of 103 wheels is concerned. The manufacturer may, however, offer the wheels of the other two shrinkage or stencil numbers, provided they are acceptable in other respects as constituents of another 103 wheels for a subsequent test. If two of the three test wheels fail in limits of chill, the wheels in the lot of 103 of the same shrinkage or stencil number as these two wheels will be rejected, and, as before, the test will be regarded as finished so far as this lot of 103 wheels is concerned. The manufacturer may, however, offer the wheels of the third shrinkage or

stencil number, provided they are acceptable in other respects, as constituents of another 103 wheels for a subsequent test. If all three test wheels fail in limits of chill, of course the whole hundred will be rejected.

8. The manufacturer must notify when he is ready to ship not less than 100 wheels; must await the arrival of the inspector; must have a car, or cars, ready to be loaded with the wheels, and must furnish facilities and labor to enable the inspector to inspect, test, load and ship the wheels promptly. Wheels offered for inspection must not be covered with any substance which will hide defects. **Inspection and Shipping.**

9. A hundred or more wheels being ready for test, the inspector will make a list of the wheel numbers, at the same time examining each wheel for defects. Any wheels which fail to conform to specifications by reason of defects must be laid aside, and such wheels will not be accepted for shipment. As individual wheels are rejected, others of the proper shrinkage, or stencil number, may be offered to keep the number good.

10. The inspector will retape not less than 10 per cent of the wheels offered for test, and if he finds any showing wrong tape-marking, he will tape the whole lot and require them to be restenciled, at the same time having the old stencil marks obliterated. He will weigh and make check measurements of at least 10 per cent. of the wheels offered for test, and if any of these wheels fail to conform to the specification, he will weigh and measure the whole lot, refusing to accept for shipment any wheels which fail in these respects. **Retaping.**

11. Experience indicates that wheels with higher shrinkage or lower stencil numbers are more apt to fail on thermal test; more apt to fail on drop test, and more apt to exceed the maximum allowable chill than those with higher stencil or lower shrinkage numbers; while, on the other hand, wheels with higher stencil or lower shrinkage numbers are more apt to be deficient in chill. For each 103 wheels apparently acceptable, the inspector will select three wheels for test—one from each of the three shrinkage or stencil numbers offered. One of these wheels chosen for this purpose by the inspector must be tested by drop test as follows: The wheel must be placed flange downward in an anvil block weighing not less than 1,700 pounds, set on rubble masonry two **Drop Tests.**

feet deep and having three supports not more than five inches wide for the flange of the wheel to rest on. It must be struck centrally upon the hub by a weight of 200 pounds, falling from a height as shown in the table in Section 3. The end of the falling weight must be flat, so as to strike fairly on the hub, and when by wear the bottom of the weight assumes a round or conical form, it must be replaced. The machine for making this test is shown on drawings which will be furnished. Should the wheel stand without breaking in two or more pieces, the number of blows, shown in the above table, the one hundred wheels represented by it will be considered satisfactory as to this test. Should it fail, the whole hundred will be rejected.

**Thermal Test.** 12. The other two test wheels must be tested as follows: The wheels must be laid flange down in the sand, and a channelway one and one-half inches in width at the center of the tread and four inches deep must be molded with green sand around the wheel. The clean tread of the wheel must form one side of this channelway, and the clean flange must form as much of the bottom as its width will cover. The channelway must then be filled to the top from one ladle with molten cast iron, which must be poured directly into the channelway without previous cooling or stirring, and this iron must be so hot, when poured, that the ring which is formed when the metal is cold shall be solid or free from wrinkles or layers. Iron at this temperature will usually cut a hole at the point of impact with the flange. In order to avoid spitting during the pouring, the tread and inside of the flange during the thermal test should be covered with a coat of shellac; wheels which are wet or which have been exposed to snow or frost may be warmed sufficiently to dry them or remove the frost before testing, but under no circumstances must the thermal test be applied to a wheel that in any part feels warm to the hand. The time when pouring ceases must be noted, and two minutes later an examination of the wheel under test must be made. If the wheel is found broken in pieces, or if any crack in the plates extends through or into the tread, the test wheel will be regarded as having failed. If both wheels stand, the whole hundred will be accepted as to this test. If both fail, the whole hundred will be rejected. If one only of the thermal test wheels fails, all of the lot under test of the same shrinkage or stencil number will be

rejected, and the test will be regarded as finished, so far as this lot of wheels is concerned. The manufacturer may, however, offer the wheels of the other two shrinkage or stencil numbers, provided they are acceptable in other respects, as constituents of another 103 wheels for a subsequent test.

13. All wheels which pass inspection and test will be regarded as accepted, and may be either shipped or stored for future shipment, as arranged. It is desired that shipments should be, as far as possible, in lots of 100 wheels. In all cases the inspector must witness the shipment, and he must give, in his report, the numbers of all wheels inspected and the disposition made of them. **Storing and Shipping.**

14. Individual wheels will be considered to have failed and will not be accepted or further considered, which, **Rejections.**

*First.* Do not conform to standard design and measurement.

*Second.* Are under or over weight.

*Third.* Have the physical defects described in Section 6.

15. Each 103 wheels submitted for test will be considered to have failed and will not be accepted or considered further, if, **Rejections.**

*First.* The test wheels do not conform to Section 7, especially as to limits of white iron in the throat and tread and around chaplets.

*Second.* One of the test wheels does not stand the drop test as described in Section 11.

*Third.* Both of the two test wheels do not stand the thermal test as described in Section 12.

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# STANDARD SPECIFICATIONS FOR GRAY-IRON CASTINGS.

ADOPTED SEPTEMBER 1, 1905.

**Process of Manufacture.** 1. Unless furnace iron is specified, all gray castings are understood to be made by the cupola process.

**Chemical Properties.** 2. The sulphur contents to be as follows:

| | | |
|---|---|---|
| Light castings | not over 0.08 | per cent. |
| Medium castings | " 0.10 | " |
| Heavy casting | " 0.12 | " |

**Classification.** 3. In dividing castings into light, medium and heavy classes, the following standards have been adopted:

Castings having any section less than ½-inch thick shall be known as *light castings.*

Castings in which no section is less than 2 inches thick shall be known as *heavy castings.*

*Medium castings* are those not included in the above classification.

**Physical Properties.** 4. *Transverse Test.* The minimum breaking strength of the "Arbitration Bar" under transverse load shall be not under:

| | |
|---|---|
| Light castings | 2,500 lbs. |
| Medium castings | 2,900 " |
| Heavy castings | 3,300 " |

In no case shall the deflection be under 0.10 inch.

*Tensile Test.* Where specified, this shall not run less than:

| | |
|---|---|
| Light castings | 18,000 lbs. per sq. in. |
| Medium castings | 21,000 " " " |
| Heavy castings | 24,000 " " " |

**Arbitration Bar.**

5. The quality of the iron going into castings under specification shall be determined by means of the "Arbitration Bar." This is a bar 1¼ inches in diameter and 15 inches long. It shall be prepared as stated further on and tested transversely. The tensile test is not recommended, but in case it is called for, the bar as shown in Fig. 1, and turned up from any of the broken pieces of the transverse test shall be used. The expense of the tensile test shall fall on the purchaser.

**Number of Test Bars.**

6. Two sets of two bars shall be cast from each heat, one set from the first and the other set from the last iron going into the castings. Where the heat exceeds twenty tons, an additional set

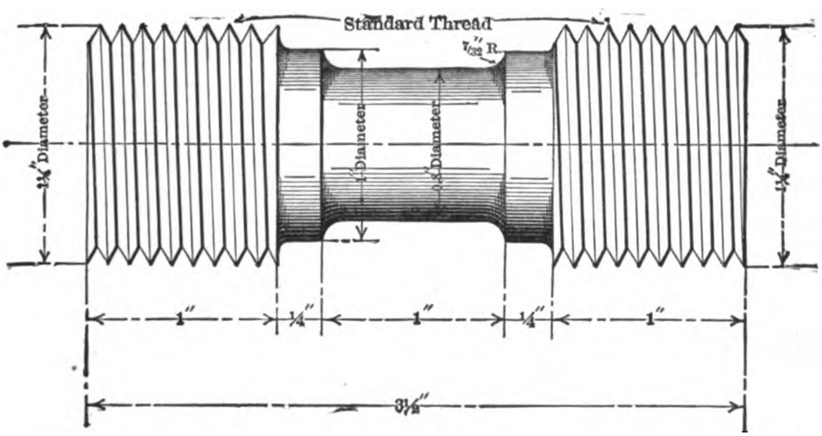


FIG. 1.—ARBITRATION TEST BAR. TENSILE TEST PIECE.

of two bars shall be cast for each twenty tons or fraction thereof above this amount. In case of a change of mixture during the heat, one set of two bars shall also be cast for every mixture other than the regular one. Each set of two bars is to go into a single mold. The bars shall not be rumbled or otherwise treated, being simply brushed off before testing.

**Method of Testing.**

7. The transverse test shall be made on all the bars cast, with supports 12 inches apart, load applied at the middle, and the deflection at rupture noted. One bar of every two of each set made must fulfil the requirements to permit acceptance of the castings represented.

**Mold for Test Bar.**

8. The mold for the bars is shown in Fig. 2. The bottom of the bar is $\frac{1}{16}$ inch smaller in diameter than the top, to allow for draft and for the strain of pouring. The pattern shall not be rapped before withdrawing. The flask is to be rammed up with green molding sand, a little damper than usual, well mixed and

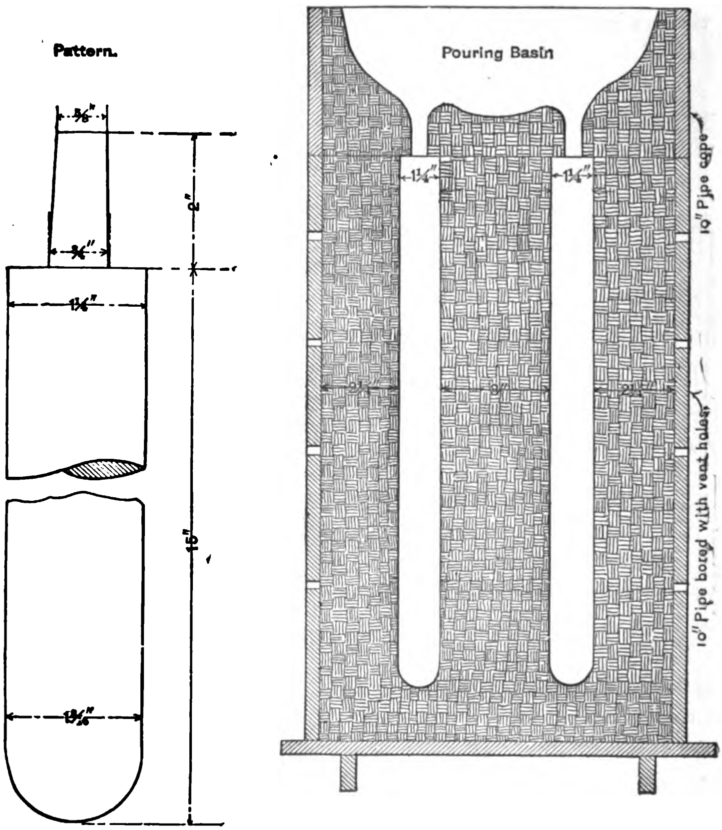


FIG. 2.—MOLD FOR ARBITRATION TEST BAR.

put through a No. 8 sieve, with a mixture of one to twelve bituminous facing. The mold shall be rammed evenly and fairly hard, thoroughly dried and not cast until it is cold. The test bar shall not be removed from the mold until cold enough to be handled.

**Speed of Testing.**

9. The rate of application of the load shall be from 20 to 40 seconds for a deflection of 0.10 inch.

10. Borings from the broken pieces of the "Arbitration Bar" shall be used for the sulphur determinations. One determination for each mold made shall be required. In case of dispute, the standards of the American Foundrymen's Association shall be used for comparison. **Samples for Analysis.**

11. Castings shall be true to pattern, free from cracks, flaws and excessive shrinkage. In other respects they shall conform to whatever points may be specially agreed upon. **Finish.**

12. The inspector shall have reasonable facilities afforded him by the manufacturer to satisfy him that the finished material is furnished in accordance with these specifications. All tests and inspections shall, as far as possible, be made at the place of manufacture prior to shipment. **Inspection.**

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# STANDARD SPECIFICATIONS FOR MALLEABLE CASTINGS.

ADOPTED NOVEMBER 15, 1904.

**Process of Manufacture.** 1. Malleable iron castings may be made by the open-hearth, air furnace, or cupola process. Cupola iron, however, is not recommended for heavy nor for important castings.

**Chemical Properties.** 2. Castings for which physical requirements are specified shall not contain over 0.06 sulphur nor over 0.225 phosphorus.

**Physical Properties.** 3. *Standard Test Bar.* This bar shall be 1 inch square and 14 inches long, without chills and with ends left perfectly free in the mold. Three shall be cast in one mold, heavy risers insuring sound bars. Where the full heat goes into castings which are subject to specification, one mold shall be poured two minutes after tapping into the first ladle, and another mold from the last iron of the heat. Molds shall be suitably stamped to insure identification of the bars, the bars being annealed with the castings. Where only a partial heat is required for the work in hand, one mold should be cast from the first ladle used and another after the required iron has been tapped.

(*a*) Of the three test bars from the two molds required for each heat, one shall be tested for tensile strength and elongation, the other for transverse strength and deflection. The other remaining bar is reserved for either the transverse or tensile test, in case of the failure of the two other bars to come up to requirements. The halves of the bars broken transversely may also be used for the tensile test.

(*b*) Failure to reach the required limit for the tensile strength with elongation, as also the transverse strength with deflection, on the part of at least one test, rejects the castings from that heat.

4. *Tensile Test.* The tensile strength of a standard test bar for castings under specification shall not be less than 40,000 pounds per square inch. The elongation measured in 2 inches shall not be less than 2½ per cent.

5. *Transverse Test.* The transverse strength of a standard test bar, on supports 12 inches apart, pressure being applied at center, shall not be less than 3,000 pounds, deflection being at least ½ inch.

6. Castings of special design or of special importance may be provided with suitable test lugs at the option of the inspector. At least one of these lugs shall be left on the casting for his inspection upon his request therefor. **Test Lugs.**

7. Malleable castings shall neither be "over" nor "under" annealed. They must have received their full heat in the oven at least sixty hours after reaching that temperature. **Annealing.**

The "saggers" shall not be dumped until the contents shall at least be "black hot."

8. Castings shall be true to pattern, free from blemishes, scale or shrinkage cracks. A variation of $\frac{1}{16}$ inch per foot shall be permissible. Founders shall not be held responsible for defects due to irregular cross sections and unevenly distributed metal. **Finish.**

9. The inspector representing the purchaser shall have all reasonable facilities given him by the founder to satisfy him that the finished material is furnished in accordance with these specifications. All tests and inspections shall be made prior to shipment. **Inspection.**

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## STANDARD SPECIFICATIONS FOR STAYBOLT IRON.

ADOPTED SEPTEMBER 1, 1910.

### PROCESS OF MANUFACTURE.

All staybolt iron must be hammered or rolled from a bloom or a box-pile having a cross-sectional area of at least 45 sq. ins., and not less than 18 ins. long, the basis of which must be pig metal and entirely free from any admixture of steel.

### PHYSICAL TESTS.

(a) *Tensile Strength.*—Not less than 48,000 lbs. per sq. in.

(b) *Elongation.*—Not less than 28 per cent. in 8 ins.

(c) *Reduction of Area.*—Not less than 45 per cent.

(d) *Double Bending Test.*—Close in both directions without flaws.

(e) *Nick and Break Test.*—A bar, nicked all around to a depth not less than 8 per cent. and not more than 16 per cent. of the diameter of the bar, and broken, shall show a clean fiber entirely free from crystallization.

(f) *Vibration Test.*—The test bar shall stand a minimum of 6,000 revolutions when subjected to the following vibratory test:

A threaded specimen, fixed at one end, has the other end moved in a circular path while stressed with a tensile load of 4,000 lbs. The circle described shall have a radius of $\frac{3}{32}$ in. at a point 8 ins. from the fixed end of the specimen.

## INSPECTION.

(*a*) The iron must be smoothly rolled and free from slivers, depressions, seams, crop ends and evidences of being burnt.

(*b*) It must be truly round within 0.01 in., and must not be more than 0.005 in. above, or more than 0.01 in. below specified sizes.

## SELECTION OF SAMPLES FOR TEST.

The bars will be sorted into lots of 100 bars each and two bars will be selected at random from each pile. Failure of either of these bars to meet any of the above specifications will be cause for rejection of the lot which the tests represent.

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## STANDARD SPECIFICATIONS FOR HARD-DRAWN COPPER WIRE.

ADOPTED AUGUST 16, 1909.

**Material.** 1. The material shall be copper of such quality and purity that, when drawn hard, it shall have the properties and characteristics herein required.

**Shapes.** 2. These specifications cover hard-drawn round wire, grooved trolley wire and hard-drawn cable or strand, as hereinafter described.

**Finish.** 3. The wire, in all shapes, must be free from all surface imperfections not consistent with the best commercial practice.

**Packages.** 4. (*a*) Package sizes for round wire and for cable shall be agreed upon in the placing of individual orders; standard packages of grooved trolley wire shall be shipments upon reels holding about 2,500 lbs. each.

(*b*) The wire shall be protected against damage in ordinary handling and shipping.

**Specific Gravity.** 5. For the purpose of calculating weights, cross sections, etc., the specific gravity of copper shall be taken as 8.90.

**Inspection.** 6. All testing and inspection shall be made at the place of manufacture. The manufacturer shall afford the inspector representing the purchaser all reasonable facilities to enable him to satisfy himself that the material conforms to the requirements of these specifications.

## HARD-DRAWN ROUND WIRE.

7. (*a*) Size shall be expressed as the diameter of the wire in decimal fractions of an inch, using not more than three places of decimals; i. e., in mills. **Dimensions and Permissible Variations.**

(*b*) Wire is expected to be accurate in diameter; permissible variations from nominal diameter shall be:

For wire 0.100 in. in diameter and larger, one per cent. over or under.

For wire less than 0.100 in. in diameter, one mill over or under.

(*c*) Each coil is to be gauged at three places, one near each end, and one approximately at the middle; the coil may be rejected if, two points being within the accepted limits, the third point is off gauge more than 2 per cent. in the case of wire 0.064 in. in diameter and larger, or more than 3 per cent. in the case of wire less than 0.064 in. in diameter.

8. The wire shall be so drawn that its tensile strength and elongation shall be at least equal to the values stated in the following table. Tensile tests shall be made upon fair samples, and the **Physical Tests.**

| Diameter, inches. | Area, circular mills. | Tensile Strength, lbs. per sq. in. | Elongation in 10 ins., per cent. |
|---|---|---|---|
| 0.460 | 211,600 | 49,000 | 2.7 |
| 0.410 | 168,100 | 51,000 | 2.6 |
| 0.365 | 133,200 | 53,000 | 2.4 |
| 0.325 | 105,600 | 54,500 | 2.3 |
| 0.289 | 83,520 | 56,000 | 2.1 |
| 0.258 | 66,560 | 57,500 | 2.0 |
| 0.229 | 52,440 | 58,500 | 1.9 |
| 0.204 | 41,620 | 59,500 | 1.8 |
| 0.182 | 33,120 | 60,500 | 1.7 |
| 0.162 | 26,240 | 61,500 | 1.6 |
| 0.144 | 20,740 | 62,500 | 1.5 |
| 0.128 | 16,380 | 63,400 | 1.4 |
| 0.114 | 12,996 | 64,200 | 1.3 |
| 0.102 | 10,404 | 64,800 | 1.2 |
| 0.091 | 8,281 | 65,400 | 1.1 |
| 0.081 | 6,561 | 65,700 | 1.0 |
| 0.072 | 5,184 | 66,000 | 0.9 |
| 0.064 | 4,096 | 66,200 | 0.9 |
| 0.057 | 3,249 | 66,400 | 0.8 |
| 0.051 | 2,601 | 66,600 | 0.8 |
| 0.045 | 2,025 | 66,800 | 0.7 |
| 0.040 | 1,600 | 67,000 | 0.7 |

elongation shall be determined as the permanent increase in length, due to the breaking of the wire in tension, measured between bench marks placed upon the wire originally 10 ins. apart. The fracture shall be between the bench marks, and not closer than 1 in. to either mark. If, upon testing a sample from any coil of wire, the results are found to be below the values stated in the table, tests upon two additional samples shall be made, and the average of the three tests shall determine acceptance or rejection of the coil. For wire whose nominal diameter is between listed sizes, the requirements shall be those of the next larger size included in the table.

**Electric Conductivity.**

9. Electric conductivity shall be determined upon fair samples by resistance measurements at a temperature of 20° C. (68° F.). The wire shall not exceed the following limits:

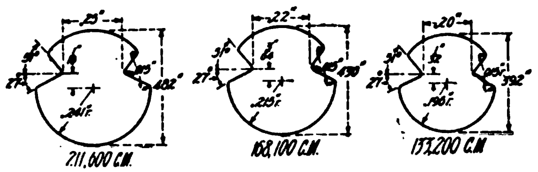
For diameters 0.460 in. to 0.325 in., 900.77 lbs. per mile-ohm at 20° C.

For diameters 0.324 in. to 0.040 in., 910.15 lbs. per mile-ohm at 20° C.

## GROOVED TROLLEY WIRE.

**Sections.**

10. Standard sections shall be those known as the "American Standard" grooved trolley wire sections, the shape and dimensions of which are as follows:




**Dimensions and Permissible Variations.**

11. (*a*) Size shall be expressed as the area of cross section in circular mills, the standard sizes being as follows:

| | | | | | |
|---|---|---|---|---|---|
| 211,600 | circular mills, | weighing | 3,386 | lbs. | per mile. |
| 168,100 | " | " | 2,690 | " | " " |
| 133,200 | " | " | 2,132 | " | " " |

(*b*) Grooved trolley wire may vary 4 per cent. over or under in weight per unit length from standard, as determined from the nominal cross section.

12. The physical tests shall be made in the same manner as those upon round wire. The tensile strength of grooved wire shall be at least 95 per cent. of that required for round wire of the same sectional area; the elongation shall be the same as that required for round wire of the same sectional area. **Physical Tests.**

13. The requirements for electric conductivity shall be the same as those for round wire of the same sectional area. **Electric Conductivity.**

## HARD-DRAWN COPPER WIRE CABLE OR STRAND.

14. For the purposes of these specifications, standard cable shall be that made up of hard-drawn wire laid concentrically about a hard-drawn wire center. Cable laid up about a hemp center or about a soft wire core is to be subject to special specifications to be agreed upon in individual cases. **Construction.**

15. The wire entering into the construction of stranded cable shall, before stranding, meet all the requirements of round wire, hereinbefore stated. **Wire.**

16. The tensile strength of standard cable shall be at least 90 per cent. of the total strength required of the wires forming the cable. **Physical Tests.**

17. Brazes, made in accordance with the best commercial practice, will be permitted in wire entering into cable; but no two brazes in wire in the cable may be closer together than 50 ft. **Brazes.**

18. The pitch of standard cable shall be not less than 12, nor more than 16, diameters of the cable. The cable shall be laid left-handed or right-handed, as shall be agreed upon in the placing of individual orders. **Lay.**

## EXPLANATORY NOTES ON STANDARD SPECIFICATIONS FOR HARD-DRAWN COPPER WIRE.

5. The specific gravity of copper has been commonly accepted as 8.9, and this value is retained in these specifications. The maximum variation from this figure in a large number of samples of wire has not been sufficient to lead one to anticipate any serious error from its use as a flat value in calculations.

7. (*a*) The use of arbitrary gauge numbers to express dimensions cannot be too strongly condemned. There are many such gauges in existence, and confusion is to be expected unless the

particular gauge to be used is specified. Many of the gauges have their dimensions stated in absurd figures, such as 0.090742 in., when it is not especially easy to measure dimensions in the fourth decimal place by workshop tools. Definite diameters in measurable units are evidently preferable.

8. Many other physical tests than those provided in these specifications are included in existing specifications. The reasons for the omission of some of the more common are given as follows:

*Twist Tests.*—The wire is sometimes required to permit twisting through a stated number of revolutions before breaking. The results are so easily influenced by temperature, speed of rotation, method of gripping, and other variables not easily defined or controlled, that the test is at least of doubtful value. It is the opinion of the Committee that it is impractical to so define the conditions of the test that a twist test can be made definite and reliable; hence there is no warrant for its inclusion in specifications.

*Wrap Tests.*—Wire is sometimes required to permit tight wrapping about a wire of its own diameter, unwrapping and again re-wrapping. It is obvious that the making of a test of this kind with wire that is already hard-drawn is exceedingly difficult. Every one who has tried to break off a piece of tough wire by bending it back and forth between the fingers knows how hard it is to confine the bend to one place, because of the hardening action of the previous bends. Hard wire which has been wrapped around a wire of small diameter is hardened still more and it is almost impossible to straighten the wire, let alone re-coil it in the opposite direction. In the opinion of the Committee, it is inadvisable to include a test which at best is so indefinite as a wrap test. Furthermore, it is the opinion of the Committee that wire which will meet the physical tests included in these specifications will meet any properly made twist or wrap test that would reasonably be required.

*Elastic Limit.*—During the tension test on wire, there is seldom to be observed any definite drop of the beam or increase in the rate of elongation, corresponding to the yield point commonly observed in testing steel. The only way in which the elastic limit of hard wire may be determined is by the actual plotting of the elastic curve from extensometer readings. Even such tests are difficult of interpretation, because the wire when available for tests

is usually curved, due to its having been put up in a coil. There are little sets observable before the true elastic limit has been reached, owing to the fact that one side of the wire, having been stretched in coiling, is really a little harder than the other side, and the pull is, therefore, not even. Considering the difficulty of making the test and the uncertainty of the results obtained, it is the opinion of the Committee that it would be inadvisable to include an elastic limit test in these specifications. It is evident that if the designing engineer requires a knowledge of the location of the elastic limit for purposes of calculation in designing, such data can be obtained by special tests on representative sizes of wire, which will fix the relation of the elastic limit to the ultimate strength for all wire which is properly made.

*Elongation.*—Elongation tests on wire are required in different specifications to be measured in lengths varying from 8 to 60 ins. The elongation has variously been measured as the permanent increase in the length of the wire, measured between bench marks placed on the wire before fracture; as the elongation measured between the jaws of the testing machine, which are adjusted to grip the wire with a certain definite free length; and in various other ways. Perhaps the most commonly used length is 10 ins., and it is a good length, because measurements may be immediately transposed into percentages without laborious calculation. Measurement of elongation in any other way than as the permanent increase in length between bench marks, in the manner customary in the measurement of elongation of steel specimens, is open to criticism. If measurements are made between the jaws of the testing machine, there is included a certain amount of elongation which has taken place within the jaws, because the wire in stretching will have been reduced in diameter and, therefore, have stretched to a greater or less extent within the jaws themselves. If the measurement is made between bench marks on the wire just prior to breakage, there is included in the elongation a certain amount of elastic deformation.

9. Electric conductivity is usually expressed as a percentage on the Matthiesen basis, reference being made to determinations of the electrical resistivity of supposedly pure copper by Matthiesen, about 1865. Since that time, the methods of refining copper have greatly improved, so that to-day it is not uncommon to find copper

of over 100 per cent. conductivity on the Matthiesen basis. Furthermore, what the electrical engineer requires is that the wire shall not exceed a certain maximum electrical resistance. It seems obvious that it is less laborious to express quantities in direct definite terms, rather than by reference to something else which requires interpretation before the results are ready for use in calculation. Resistivity is commonly expressed in a number of different ways, all being equivalent to the resistance of some unit of cross section, this unit being expressed either in linear dimensions or as a combination of weight and dimensions. For convenience, we give a table of equivalents of the values for electrical resistance included in these specifications. The values are equivalent respectively to 97 per cent. and 96 per cent. conductivity on the Matthiesen basis.

900.77 lbs. per mile-ohm is equal to:
0.15776 ohms per meter-gram,
1.7726 microhms per centimeter-cube,
0.69789 microhms per inch-cube,
10.663 ohms per mill-foot.

910.15 lbs. per mile-ohm is equal to:
0.15941 ohms per meter-gram,
1.7911 microhms per centimeter-cube,
0.70517 microhms per inch-cube,
10.774 ohms per mill-foot.

10. It is obvious that the simplest designation of irregular shapes of similar outline is by sectional area, and the most commonly used unit among electrical engineers is the circular mill. Therefore, while the sizes of grooved trolley wire regularly used are generally known by B & S gauge number, corresponding to their sectional area, it has been deemed advisable by the Committee to list these sizes, in specifications, by their sectional area expressed in circular mills. The three sizes which are most extensively used commercially are the only ones listed; a fourth size is but little used, and the use is growing less.

11. The only way in which gauge variations are easily determinable in irregular shapes is by recourse to weights of standard lengths, and this has been the method adopted in the specifications.

14. So many variations in the construction of cable are possible that it has been deemed inadvisable to complicate the specifications by including requirements for any other than the one type most commonly used.

16. Physical testing of cable is at best a difficult matter, and the measurement of elongation in cable which has been subjected to a tensile test is uncertain, since it includes the elastic deformation of the cable as a spring, the actual elongation of the wires, and perhaps even some elastic deformation of the wires as such. It is, therefore, thought inadvisable to include a requirement covering an elongation test.

17. The permitting of brazes in wire entering into the construction of copper cable was discussed at considerable length, and it is finally the opinion of the Committee that, provided no two brazes are closer together than 50 ft., the cable has fully 90 per cent. of the theoretical strength obtained by adding together the required strengths of the constituent wires. This is due, in such long lengths, to the frictional gripping of the wires in the cable. The construction of long lengths of cable without brazes is costly, and it has been thought best, therefore, to permit their use, provided they are sufficiently widely spaced as not to be detrimental to the strength of the cable.

# AMERICAN SOCIETY FOR TESTING MATERIALS

PHILADELPHIA, PA., U. S. A.

AFFILIATED WITH THE

INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.

## STANDARD SPECIFICATIONS FOR CEMENT.

ADOPTED AUGUST 16, 1909.

### GENERAL OBSERVATIONS.

1. These remarks have been prepared with a view of pointing out the pertinent features of the various requirements and the precautions to be observed in the interpretation of the results of the tests.

2. The Committee would suggest that the acceptance or rejection under these specifications be based on tests made by an experienced person having the proper means for making the tests.

### SPECIFIC GRAVITY.

3. Specific gravity is useful in detecting adulteration. The results of tests of specific gravity are not necessarily conclusive as an indication of the quality of a cement, but when in combination with the results of other tests may afford valuable indications.

### FINENESS.

4. The sieves should be kept thoroughly dry.

### TIME OF SETTING.

5. Great care should be exercised to maintain the test pieces under as uniform conditions as possible. A sudden change or wide range of temperature in the room in which the tests are made, a very dry or humid atmosphere, and other irregularities vitally affect the rate of setting.

### CONSTANCY OF VOLUME.

6. The tests for constancy of volume are divided into two classes, the first normal, the second accelerated. The latter should be regarded as a precautionary test only, and not infallible. So many conditions enter into the making and interpreting of it that it should be used with extreme care.

7. In making the pats the greatest care should be exercised to avoid initial strains due to molding or to too rapid drying-out during the first twenty-four hours. The pats should be preserved under the most uniform conditions possible, and rapid changes of temperature should be avoided.

8. The failure to meet the requirements of the accelerated tests need not be sufficient cause for rejection. The cement may, however, be held for twenty-eight days, and a retest made at the end of that period, using a new sample. Failure to meet the requirements at this time should be considered sufficient cause for rejection, although in the present state of our knowledge it cannot be said that such failure necessarily indicates unsoundness, nor can the cement be considered entirely satisfactory simply because it passes the tests.

## SPECIFICATIONS.

### GENERAL CONDITIONS.

1. All cement shall be inspected.

2. Cement may be inspected either at the place of manufacture or on the work.

3. In order to allow ample time for inspecting and testing, the cement should be stored in a suitable weather-tight building having the floor properly blocked or raised from the ground.

4. The cement shall be stored in such a manner as to permit easy access for proper inspection and identification of each shipment.

5. Every facility shall be provided by the Contractor and a period of at least twelve days allowed for the inspection and necessary tests.

6. Cement shall be delivered in suitable packages with the brand and name of manufacturer plainly marked thereon.

7. A bag of cement shall contain 94 pounds of cement net. Each barrel of Portland cement shall contain 4 bags, and each barrel of natural cement shall contain 3 bags of the above net weight.

8. Cement failing to meet the seven-day requirements may be held awaiting the results of the twenty-eight-day tests before rejection.

9. All tests shall be made in accordance with the methods proposed by the Committee on Uniform Tests of Cement of the American Society of Civil Engineers, presented to the Society January 21, 1903, and amended January 20, 1904, and January 15, 1908, with all subsequent amendments thereto. (See addendum to these specifications.)

10. The acceptance or rejection shall be based on the following requirements:

## NATURAL CEMENT.

11. *Definition.* This term shall be applied to the finely pulverized product resulting from the calcination of an argillaceous limestone at a temperature only sufficient to drive off the carbonic acid gas.

### FINENESS.

12. It shall leave by weight a residue of not more than 10 per cent. on the No. 100, and 30 per cent. on the No. 200 sieve.

### TIME OF SETTING.

13. It shall not develop initial set in less than ten minutes; and shall not develop hard set in less than thirty minutes, or in more than three hours.

### TENSILE STRENGTH.

14. The minimum requirements for tensile strength for briquettes one square inch in cross section shall be as follows, and the cement shall show no retrogression in strength within the periods specified:

| *Age.* | *Neat Cement.* | *Strength.* |
|---|---|---|
| 24 hours in moist air | | 75 lbs. |
| 7 days (1 day in moist air, 6 days in water) | | 150 " |
| 28 days (1 " " " 27 " " ) | | 250 " |

*One Part Cement, Three Parts Standard Ottawa Sand.*

| | |
|---|---|
| 7 days (1 day in moist air, 6 days in water) | 50 lbs. |
| 28 days (1 " " " 27 " " ) | 125 " |

### CONSTANCY OF VOLUME.

15. Pats of neat cement about three inches in diameter, one-half inch thick at center, tapering to a thin edge, shall be kept in moist air for a period of twenty-four hours.

(*a*) A pat is then kept in air at normal temperature.

(*b*) Another is kept in water maintained as near 70° F. as practicable.

16. These pats are observed at intervals for at least 28 days, and, to satisfactorily pass the tests, shall remain firm and hard and show no signs of distortion, checking, cracking, or disintegrating.

### PORTLAND CEMENT.

17. *Definition.* This term is applied to the finely pulverized product resulting from the calcination to incipient fusion of an intimate mixture of properly proportioned argillaceous and calcareous materials, and to which no addition greater than 3 per cent. has been made subsequent to calcination.

### SPECIFIC GRAVITY.

18. The specific gravity of cement shall not be less than 3.10. Should the test of cement as received fall below this requirement, a second test may be made upon a sample ignited at a low red heat. The loss in weight of the ignited cement shall not exceed 4 per cent.

### FINENESS.

19. It shall leave by weight a residue of not more than 8 per cent. on the No. 100, and not more than 25 per cent. on the No. 200 sieve.

### TIME OF SETTING.

20. It shall not develop initial set in less than thirty minutes; and must develop hard set in not less than one hour, nor more than ten hours.

### TENSILE STRENGTH.

21. The minimum requirements for tensile strength for briquettes one square inch in cross section shall be as follows, and

the cement shall show no retrogression in strength within the periods specified:

| *Age.* | *Neat Cement.* | *Strength.* |
|---|---|---|
| 24 hours in moist air | | 175 lbs. |
| 7 days (1 day in moist air, 6 days in water) | | 500 " |
| 28 days (1 " " " 27 " " ) | | 600 " |

*One Part Cement, Three Parts Standard Ottawa Sand.*

| | |
|---|---|
| 7 days (1 day in moist air, 6 days in water) | 200 lbs. |
| 28 days (1 " " " 27 " " ) | 275 " |

CONSTANCY OF VOLUME.

22. Pats of neat cement about three inches in diameter, one-half inch thick at the center, and tapering to a thin edge, shall be kept in moist air for a period of twenty-four hours.

(*a*) A pat is then kept in air at normal temperature and observed at intervals for at least 28 days.

(*b*) Another pat is kept in water maintained as near 70° F. as practicable, and observed at intervals for at least 28 days.

(*c*) A third pat is exposed in any convenient way in an atmosphere of steam, above boiling water, in a loosely closed vessel for five hours.

23. These pats, to satisfactorily pass the requirements, shall remain firm and hard, and show no signs of distortion, checking, cracking, or disintegrating.

SULPHURIC ACID AND MAGNESIA.

24. The cement shall not contain more than 1.75 per cent. of anhydrous sulphuric acid ($SO_3$), nor more than 4 per cent. of magnesia (MgO).

## *ADDENDUM.*

## ABSTRACT OF METHODS RECOMMENDED BY THE SPECIAL COMMITTEE ON UNIFORM TESTS OF CEMENT OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

### SAMPLING.

1.—*Selection of Sample.*—The sample shall be a fair average of the contents of the package; it is recommended that, where conditions permit, one barrel in every ten be sampled.

2.—Samples should be passed through a sieve having twenty meshes per linear inch, in order to break up lumps and remove foreign material; this is also a very effective method for mixing them together in order to obtain an average. For determining the characteristics of a shipment of cement, the individual samples may be mixed and the average tested; where time will permit, however, it is recommended that they be tested separately.

3.—*Method of Sampling.*—Cement in barrels should be sampled through a hole made in the center of one of the staves, midway between the heads, or in the head, by means of an auger or a sampling iron similar to that used by sugar inspectors. If in bags, it should be taken from surface to center.

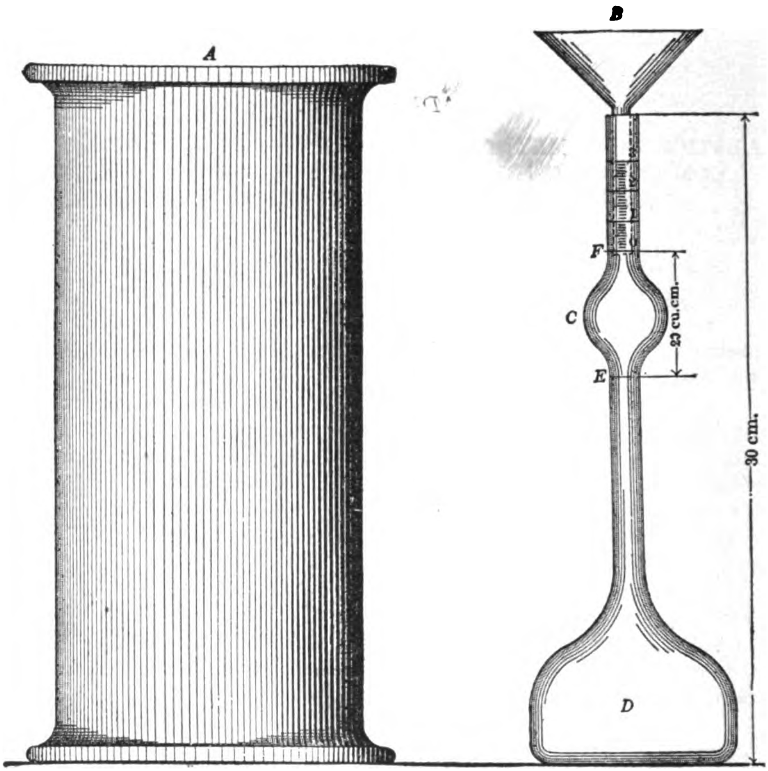
### CHEMICAL ANALYSIS.

4.—*Method.*—As a method to be followed for the analysis of cement, that proposed by the Committee on Uniformity in the Analysis of Materials for the Portland Cement Industry, of the New York Section of the Society for Chemical Industry, and published in the *Journal* of the Society for January 15, 1902, is recommended.

### SPECIFIC GRAVITY.

5.—*Apparatus and Method.*—The determination of specific gravity is most conveniently made with Le Chatelier's apparatus. This consists of a flask (*D*), Fig. 1, of 120 cu. cm. (7.32 cu. ins.) capacity, the neck of which is about 20 cm. (7.87 ins.) long; in the middle of this neck is a bulb (*C*), above and below which are two marks (*F*) and (*E*); the volume between these marks is 20 cu. cm. (1.22 cu. ins.). The neck has a diameter of about 9 mm. (0.35 in.), and is graduated into tenths of cubic centimeters above the mark (*F*).

6.—Benzine (62° Baumé naphtha), or kerosene free from water should be used in making the determination.




LE CHATELIER'S SPECIFIC GRAVITY APPARATUS
FIG. 1.

7.—The specific gravity can be determined in two ways.

(1) The flask is filled with either of these liquids to the lower mark (*E*), and 64 gr. (2.25 oz.) of powder, cooled to the temperature of the liquid, is gradually introduced through the funnel (*B*) [the stem of which extends into the flask to the top of the bulb (*C*)], until the upper mark (*F*) is reached. The difference in weight between the cement remaining and the original quantity (64 gr.) is the weight which has displaced 20 cu. cm.

8.—(2) The whole quantity of the powder is introduced, and the level of the liquid rises to some division of the graduated neck. This reading plus 20 cu. cm. is the volume displaced by 64 gr. of the powder.

9.—The specific gravity is then obtained from the formula:

$$\text{Specific Gravity} = \frac{\text{Weight of Cement, in grams.}}{\text{Displaced Volume, in cubic centimeters.}}$$

10.—The flask, during the operation, is kept immersed in water in a jar (*A*), in order to avoid variations in the temperature of the liquid. The results should agree within 0.01. The determination of specific gravity should be made on the cement as received; and, should it fall below 3.10, a second determination should be made on the sample ignited at a low red heat.

11.—A convenient method for cleaning the apparatus is as follows: The flask is inverted over a large vessel, preferably a glass jar, and shaken vertically until the liquid starts to flow freely; it is then held still in a vertical position until empty; the remaining traces of cement can be removed in a similar manner by pouring into the flask a small quantity of clean liquid and repeating the operation.

## FINENESS.

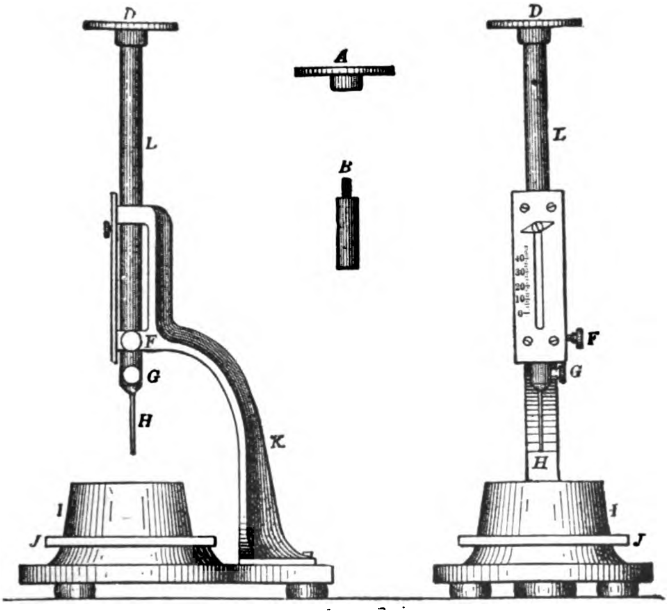
12.—*Apparatus*.—The sieves should be circular, about 20 cm. (7.87 ins.) in diameter, 6 cm. (2.36 ins.) high, and provided with a pan, 5 cm. (1.97 ins.) deep, and a cover.

13.—The wire cloth should be of brass wire having the following diameters:

No. 100, 0.0045 in.; No. 200, 0.0024 in.

14.—This cloth should be mounted on the frames without distortion; the mesh should be regular in spacing and be within the following limits:

No. 100, 96 to 100 meshes to the linear inch.
No. 200, 188 to 200 " " " "




VICAT NEEDLE.
FIG. 2.

15.—Fifty grams (1.76 oz.) or 100 gr. (3.25 oz.) should be used for the test, and dried at a temperature of 100° C. (212° F.) prior to sieving.

16.—*Method.*—The thoroughly dried and coarsely screened sample is weighed and placed on the No. 200 sieve, which, with pan and cover attached, is held in one hand in a slightly-inclined position, and moved forward and backward, at the same time striking the side gently with the palm of the other hand, at the rate of about 200 strokes per minute. The operation is continued until not more than one-tenth of 1 per cent passes through after one minute of continuous sieving. The residue is weighed, then placed on the No. 100 sieve and the operation repeated. The work may be expedited by placing in the sieve a small quantity of steel shot. The results should be reported to the nearest tenth of 1 per cent.

## NORMAL CONSISTENCY.

17.—*Method.*—This can best be determined by means of *Vicat Needle Apparatus*, which consists of a frame (*K*), Fig. 2, bearing a movable rod (*L*), with the cap (*A*) at one end, and at the other the cylinder (*B*), 1 cm. (0.39 in.) in diameter, the cap, rod and cylinder weighing 300 gr. (10.58 oz.). The rod, which can be held in any desired position by a screw (*F*), carries an indicator, which moves over a scale (graduated to centimeters) attached to the frame (*K*). The paste is held by a conical, hard-rubber ring (*I*), 7 cm. (2.76 ins) in diameter at the base, 4 cm. (1.57 ins.) high, resting on a glass plate (*J*), about 10 cm. (3.94 ins.) square.

18.—In making the determination, the same quantity of cement as will be subsequently used for each batch in making the briquettes (but not less than 500 grams) is kneaded into a paste, as described in paragraph 39, and quickly formed into a ball with the hands, completing the operation by tossing it six times from one hand to the other, maintained 6 ins. apart; the ball is then pressed into the rubber ring, through the larger opening, smoothed off and placed (on its large end) on a glass plate and the smaller end smoothed off with a trowel; the paste, confined in the ring, resting on the plate, is placed under the rod bearing the cylinder, which is brought in contact with the surface and quickly released.

19.—The paste is of normal consistency when the cylinder penetrates to a point in the mass 10 mm. (0.39 in.) below the top of the ring. Great care must be taken to fill the ring exactly to the top.

20.—The trial pastes are made with varying percentages of water until the correct consistency is obtained.

*NOTE. The Committee on Standard Specifications inserts the following table for temporary use to be replaced by one to be devised by the Committee of the American Society of Civil Engineers.*

PERCENTAGE OF WATER FOR STANDARD MIXTURES.

| Neat | 1–1 | 1–2 | 1–3 | 1–4 | 1–5 | Neat | 1–1 | 1–2 | 1–3 | 1–4 | 1–5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 18 | 12.0 | 10.0 | 9.0 | 8.4 | 8.0 | 33 | 17.0 | 13.3 | 11.5 | 10.4 | 9.6 |
| 19 | 12.3 | 10.2 | 9.2 | 8.5 | 8.1 | 34 | 17.3 | 13.6 | 11.7 | 10.5 | 9.7 |
| 20 | 12.7 | 10.4 | 9.3 | 8.7 | 8.2 | 35 | 17.7 | 13.8 | 11.8 | 10.7 | 9.9 |
| 21 | 13.0 | 10.7 | 9.5 | 8.8 | 8.3 | 36 | 18.0 | 14.0 | 12.0 | 10.8 | 10.0 |
| 22 | 13.3 | 10.9 | 9.7 | 8.9 | 8.4 | 37 | 18.3 | 14.2 | 12.2 | 10.9 | 10.1 |
| 23 | 13.7 | 11.1 | 9.8 | 9.1 | 8.5 | 38 | 18.7 | 14.4 | 12.3 | 11.1 | 10.2 |
| 24 | 14.0 | 11.3 | 10.0 | 9.2 | 8.6 | 39 | 19.0 | 14.7 | 12.5 | 11.2 | 10.3 |
| 25 | 14.3 | 11.6 | 10.2 | 9.3 | 8.8 | 40 | 19.3 | 14.9 | 12.7 | 11.3 | 10.4 |
| 26 | 14.7 | 11.8 | 10.3 | 9.5 | 8.9 | 41 | 19.7 | 15.1 | 12.8 | 11.5 | 10.5 |
| 27 | 15.0 | 12.0 | 10.5 | 9.6 | 9.0 | 42 | 20.0 | 15.3 | 13.0 | 11.6 | 10.6 |
| 28 | 15.3 | 12.2 | 10.7 | 9.7 | 9.1 | 43 | 20.3 | 15.6 | 13.2 | 11.7 | 10.7 |
| 29 | 15.7 | 12.5 | 10.8 | 9.9 | 9.2 | 44 | 20.7 | 15.8 | 13.3 | 11.9 | 10.8 |
| 30 | 16.0 | 12.7 | 11.0 | 10.0 | 9.3 | 45 | 21.0 | 16.0 | 13.5 | 12.0 | 11.0 |
| 31 | 16.3 | 12.9 | 11.2 | 10.1 | 9.4 | 46 | 21.3 | 16.1 | 13.7 | 12.1 | 11.1 |
| 32 | 16.7 | 13.1 | 11.3 | 10.3 | 9.5 | | | | | | |

| | 1 to 1 | 1 to 2 | 1 to 3 | 1 to 4 | 1 to 5 |
|---|---|---|---|---|---|
| Cement.. | 500 | 333 | 250 | 200 | 167 |
| Sand ... | 500 | 666 | 750 | 800 | 833 |

## TIME OF SETTING.

21.—*Method.*—For this purpose the Vicat Needle, which has already been described in paragraph 17, should be used.

22.—In making the test, a paste of normal consistency is molded and placed under the rod (*L*), Fig. 2, as described in paragraph 18; this rod, bearing the cap (*D*) at one end and the needle (*H*), 1 mm. (0.039 in.) in diameter, at the other, weighing 300 gr. (10.58 oz.). The needle is then carefully brought in contact with the surface of the paste and quickly released.

23.—The setting is said to have commenced when the needle ceases to pass a point 5 mm. (0.20 in.) above the upper surface of the glass plate, and is said to have terminated the moment the needle does not sink visibly into the mass.

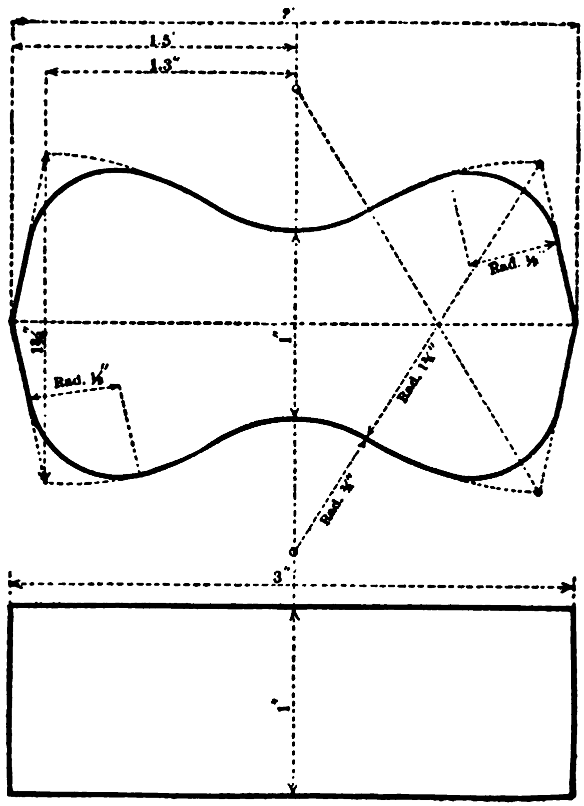
24.—The test pieces should be stored in moist air during the test; this is accomplished by placing them on a rack over water contained in a pan and covered with a damp cloth, the cloth to be kept away from them by means of a wire screen; or they may be stored in a moist box or closet.

25.—Care should be taken to keep the needle clean, as the collection of cement on the sides of the needle retards the penetration, while cement on the point reduces the area and tends to increase the penetration.

26.—The determination of the time of setting is only approximate, being materially affected by the temperature of the mixing water, the temperature and humidity of the air during the test, the percentage of water used, and the amount of molding the paste receives.

STANDARD SAND.

27.—For the present, the Committee recommends the natural sand from Ottawa, Ill., screened to pass a sieve having 20 meshes per linear inch and retained on a sieve having 30 meshes per linear inch; the wires to have diameters of 0.0165 and 0.0112 in., respectively, *i. e.* half the width of the opening in each case. Sand having passed the No. 20 sieve shall be considered standard when not more than 1 per cent passes a No. 30 sieve after one minute continuous sifting of a 500-gram sample.*




DETAILS FOR BRIQUETTE.
FIG. 3.

* The Sandusky Portland Cement Company, of Sandusky, Ohio, has agreed to undertake the preparation of this sand and to furnish it at a price only sufficient to cover the actual cost of preparation.

### FORM OF BRIQUETTE.

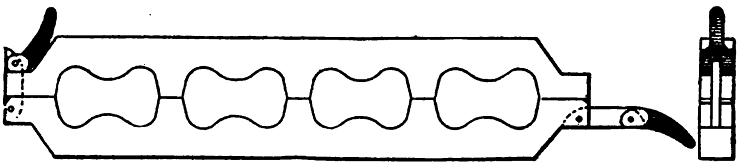
28.—While the form of the briquette recommended by a former Committee of the Society is not wholly satisfactory, this Committee is not prepared to suggest any change, other than rounding off the corners by curves of ½-in. radius, Fig. 3.

### MOLDS.

29.—The molds should be made of brass, bronze or some equally non-corrodible material, having sufficient metal in the sides to prevent spreading during molding.

30.—Gang molds, which permit molding a number of briquettes at one time, are preferred by many to single molds; since the greater quantity of mortar that can be mixed tends to produce greater uniformity in the results. The type shown in Fig. 4 is recommended.

31.—The molds should be wiped with an oily cloth before using.



DETAILS FOR GANG MOULD.
FIG. 4.

### MIXING.

32.—All proportions should be stated by weight; the quantity of water to be used should be stated as a percentage of the dry material.

33.—The metric system is recommended because of the convenient relation of the gram and the cubic centimeter.

34.—The temperature of the room and the mixing water should be as near 21° C. (70° F.) as it is practicable to maintain it.

35.—The sand and cement should be thoroughly mixed dry. The mixing should be done on some non-absorbing surface, preferably plate glass. If the mixing must be done on an absorbing surface it should be thoroughly dampened prior to use.

36.—The quantity of material to be mixed at one time depends on the number of test pieces to be made; about 1,000 gr. (35.28 oz.) makes a convenient quantity to mix, especially by hand methods.

37.—*Method.*—The material is weighed and placed on the mixing table, and a crater formed in the center, into which the proper percentage of clean water is poured; the material on the outer edge is turned into the crater by the aid of a trowel As soon as the water has been absorbed, which should not require more than one minute, the operation is completed by vigorously kneading with the hands for an additional 1½ minutes, the process being similar to that used in kneading dough. A sand-glass affords a convenient guide for the time of kneading. During the operation of mixing, the hands should be protected by gloves, preferably of rubber.

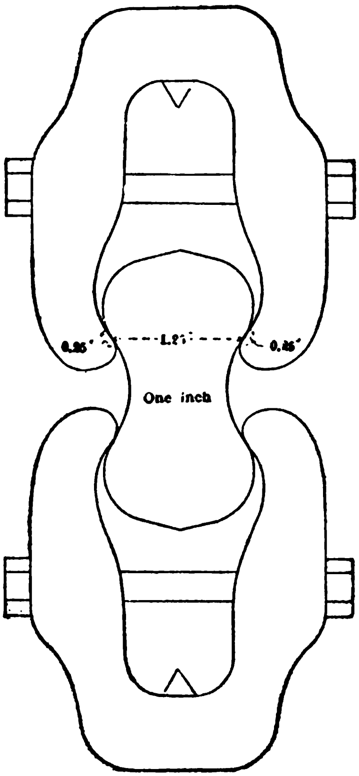
## MOLDING.

38.—Having worked the paste or mortar to the proper consistency, it is at once placed in the molds by hand.

39.—*Method.*—The molds should be filled immediately after the mixing is completed, the material pressed in firmly with the fingers, and smoothed off with a trowel, without mechanical ramming; the material should be heaped up on the upper surface of the mold, and, in smoothing off, the trowel should be drawn over the mold in such a manner as to exert a moderate pressure on the excess material. The mold should be turned over and the operation repeated.

40.—A check upon the uniformity of the mixing and molding is afforded by weighing the briquettes just prior to immersion, or upon removal from the moist closet. Briquettes which vary in weight more than 3 per cent from the average should not be tested.

## STORAGE OF THE TEST PIECES.




FORM OF CLIP.
FIG. 5.

41.—During the first 24 hours after molding, the test pieces should be kept in moist air to prevent them from drying out.

42.—A moist closet or chamber is so easily devised that the use of the damp cloth should be abandoned if possible. Covering the test pieces with a damp cloth is objectionable, as commonly used, because the cloth may dry out unequally, and in consequence the test pieces are not all maintained under the same condition. Where a moist closet is not available, a cloth may be used and kept uniformly wet by immersing the ends in water. It should be kept from direct contact with the test pieces by means of a wire screen or some similar arrangement.

43.—A moist closet consists of a soapstone or slate box, or a metal-lined wooden box—the metal lining being covered with felt and this felt kept wet. The bottom of the box is so constructed as to hold water, and the sides are provided with cleats for holding glass shelves on which to place the briquettes. Care should be taken to keep the air in the closet uniformly moist.

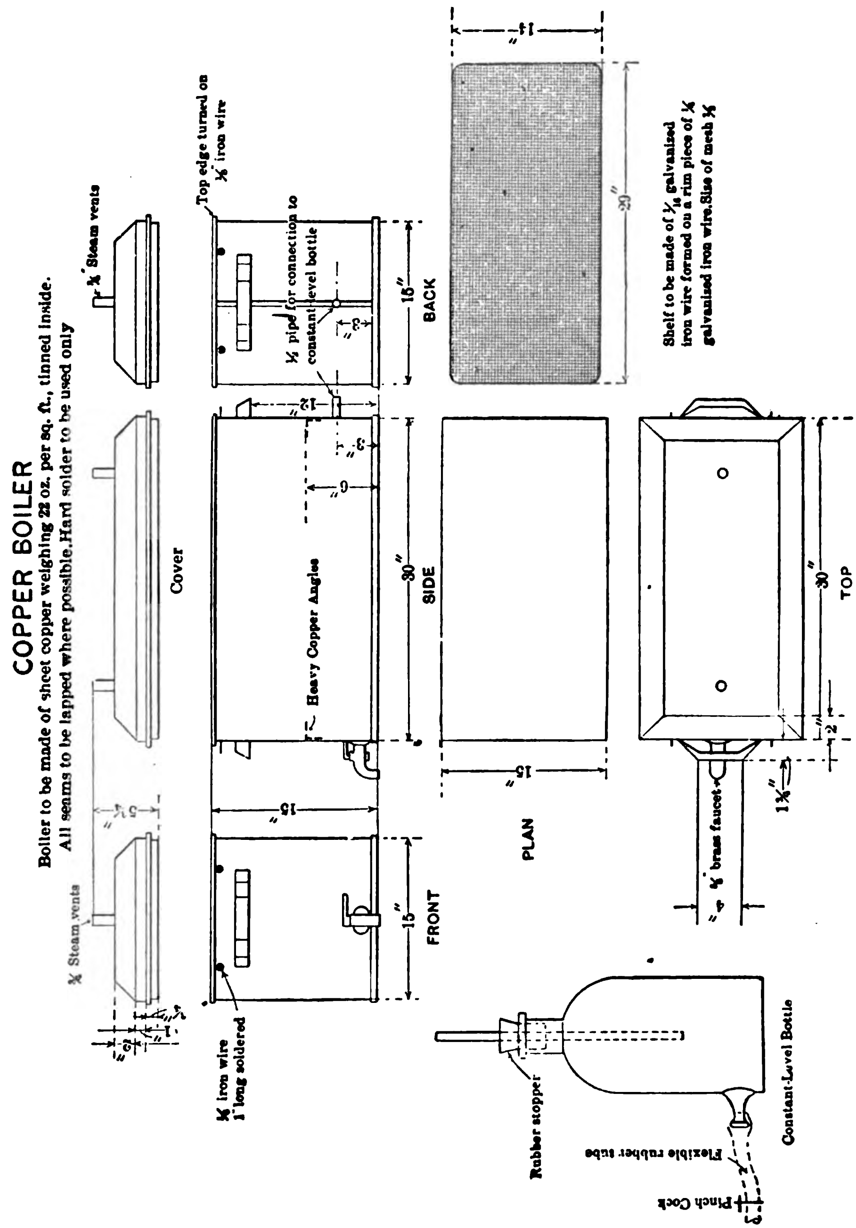

COPPER BOILER
Boiler to be made of sheet copper weighing 22 oz. per sq. ft., tinned inside.
All seams to be lapped where possible. Hard solder to be used only
Cover
¼" Steam vents
Top edge turned on ⅛" iron wire
½" pipe for connection to constant level bottle
Heavy Copper Angles
⅛" iron wire 1" long soldered
BACK
SIDE
FRONT
PLAN
TOP
Shelf to be made of 1/16 galvanized iron wire formed on a rim piece of ⅛ galvanized iron wire. Size of mesh ⅛
⅜" brass faucet
Rubber stopper
Constant-Level Bottle
Flexible rubber tube
Pinch Cock

FIG. 6.

44.—After 24 hours in moist air, the test pieces for longer periods of time should be immersed in water maintained as near 21° C. (70° F.) as practicable; they may be stored in tanks or pans, which should be of non-corrodible material.

## TENSILE STRENGTH.

45.—The tests may be made on any standard machine. A solid metal clip, as shown in Fig. 5, is recommended. This clip is to be used without cushioning at the points of contact with the test specimen. The bearing at each point of contact should be ¼ in. wide, and the distance between the center of contact on the same clip should be 1¼ ins.

46.—Test pieces should be broken as soon as they are removed from the water. Care should be observed in centering the briquettes in the testing machine, as cross-strains, produced by improper centering, tend to lower the breaking strength. The load should not be applied too suddenly, as it may produce vibration, the shock from which often breaks the briquette before the ultimate strength is reached. Care must be taken that the clips and the sides of the briquette be clean and free from grains of sand or dirt, which would prevent a good bearing. The load should be applied at the rate of 600 lbs. per minute. The average of the briquettes of each sample tested should be taken as the test, excluding any results which are manifestly faulty.

## CONSTANCY OF VOLUME.

47.—*Methods.*—Tests for constancy of volume are divided into two classes: (1) normal tests, or those made in either air or water maintained at about 21° C. (70° F.), and (2) accelerated tests, or those made in air, steam or water at a temperature of 45° C. (115° F.) and upward. The test pieces should be allowed to remain 24 hours in moist air before immersion in water or steam, or preservation in air.

48.—For these tests, pats about 7½ cm. (2.95 ins.) in diameter, 1¼ cm. (0.49 in.) thick at the center, and tapering to a thin edge, should be made, upon a clean glass plate [about 10 cm. (3.94 ins.) square], from cement paste of normal consistency.

49.—*Normal Test.*—A pat is immersed in water maintained as near 21° C. (70° F.) as possible for 28 days, and observed at intervals. A similar pat, after 24 hours in moist air, is maintained in air at ordinary temperature and observed at intervals.

50.—*Accelerated Test.*—A pat is exposed in any convenient way in an atmosphere of steam, above boiling water, in a loosely closed vessel, for 5 hours. The apparatus recommended for making these determinations is shown in Fig. 6.

51.—To pass these tests satisfactorily, the pats should remain firm and hard, and show no signs of cracking, distortion or disintegration.

52.—Should the pat leave the plate, distortion may be detected best with a straight-edge applied to the surface which was in contact with the plate.

# AMERICAN SOCIETY FOR TESTING MATERIALS

PHILADELPHIA, PA., U. S. A.

AFFILIATED WITH THE

INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.

## STANDARD CLASSIFICATION OF STRUCTURAL TIMBER.

ADOPTED SEPTEMBER 1, 1907.

### I. DEFINITION OF STRUCTURAL TIMBER.

By the term "Structural Timber" the Committee understands all such products of wood in which the strength of the timber is the controlling element in their selection and use. The following is a list of products which are recommended for consideration as structural timbers:

*Trestle Timbers.*—Stringers, caps, posts, mud sills, bracing, bridge ties, guard rails.

*Car Timbers.*—Car framing, including upper framing; car sills.

*Framing for Buildings.*—Posts, mud sills, girders, framing, joists.

*Ship Timbers.*—Ship timbers, ship decking.

*Cross Arms for Poles.*

### II. STANDARD DEFECTS.

Measurements which refer to the diameter of knots or holes should be considered as referring to the mean or average diameter.

1. *Sound Knot.*—A sound knot is one which is solid across its face and which is as hard as the wood surrounding it; it may be either red or black, and is so fixed by growth or position that it will retain its place in the piece.

2. *Loose Knot.*—A loose knot is one not firmly held in place by growth or position.

3. *Pith Knot.*—A pith knot is a sound knot with a pith hole not more than ¼ in. in diameter in the center.

4. *Encased Knot.*—An encased knot is one which is surrounded wholly or in part by bark or pitch. Where the encasement is less than ⅛ in. in width on both sides, not exceeding one-half the circumference of the knot, it shall be considered a sound knot.

5. *Rotten Knot.*—A rotten knot is one not as hard as the wood it is in.

6. *Pin Knot.*—A pin knot is a sound knot not over ½ in. in diameter.

7. *Standard Knot.*—A standard knot is a sound knot not over 1½ ins. in diameter.

8. *Large Knot.*—A large knot is a sound knot, more than 1½ ins. in diameter.

9. *Round Knot.*—A round knot is one which is oval or circular in form.

10. *Spike Knot.*—A spike knot is one sawn in a lengthwise direction; the mean or average width shall be considered in measuring these knots.

11. *Pitch Pockets.*—Pitch pockets are openings between the grain of the wood containing more or less pitch or bark. These shall be classified as *small, standard* and *large* pitch pockets.

(*a*) *Small Pitch Pocket.* A small pitch pocket is one not over ⅛ in. wide.

(*b*) *Standard Pitch Pocket.* A standard pitch pocket is one not over ⅜ in. wide, or 3 ins. in length.

(*c*) *Large Pitch Pocket.* A large pitch pocket is one over ⅜ in. wide, or over 3 ins. in length.

12. *Pitch Streak.*—A pitch streak is a well-defined accumulation of pitch at one point in the piece. When not sufficient to develop a well-defined streak, or where the fiber between grains,

Plate I.
Proc. Am. Soc. Test. Mats.
Standard Classification of Structural Timber.

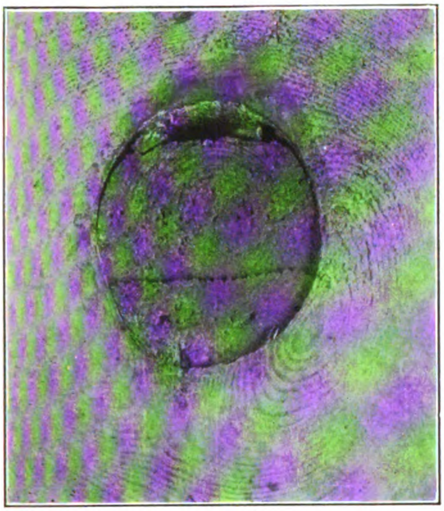


Fig. 1.—Loose Knot.

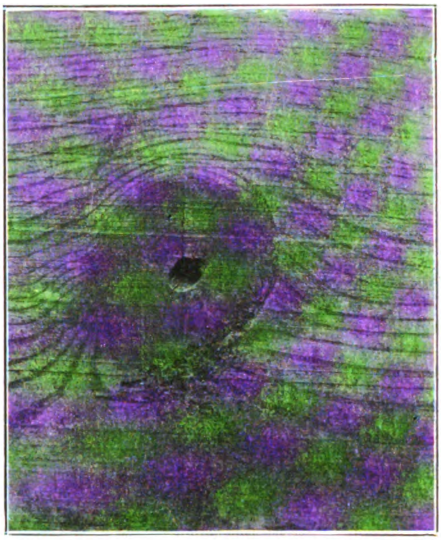


Fig. 2.—Pith Knot

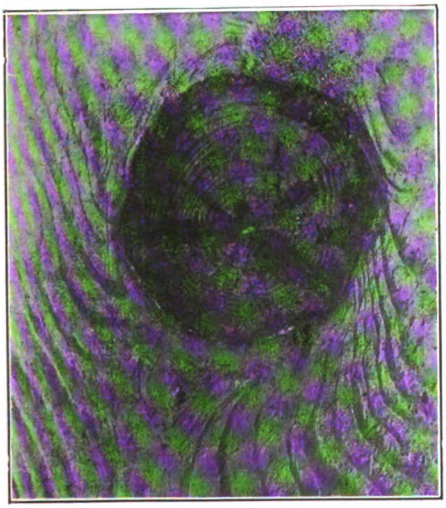


Fig. 3.—Encased Knot

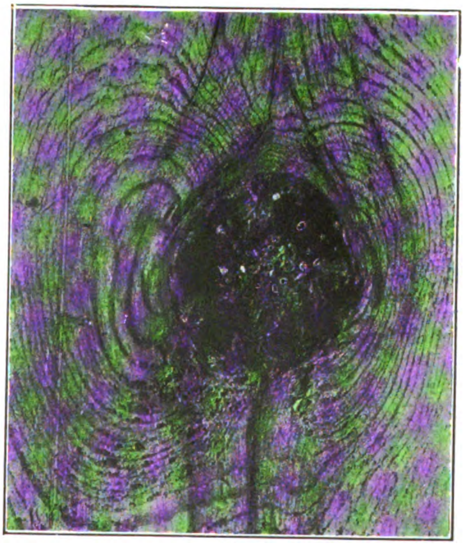


Fig. 4.—Rotten Knot

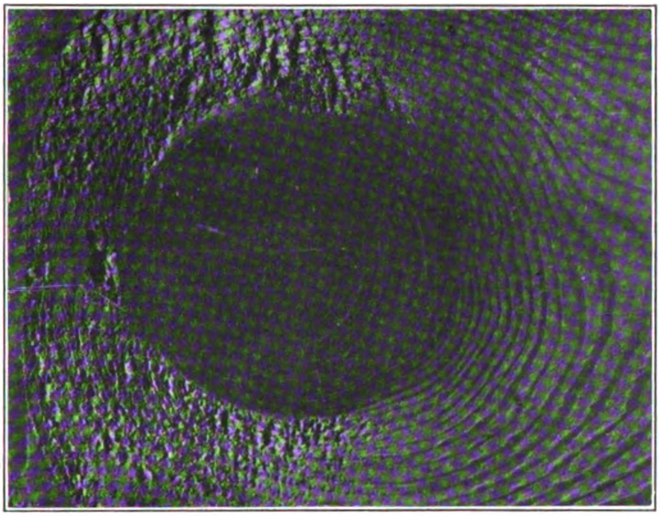


FIG. 6.—Standard Knot.

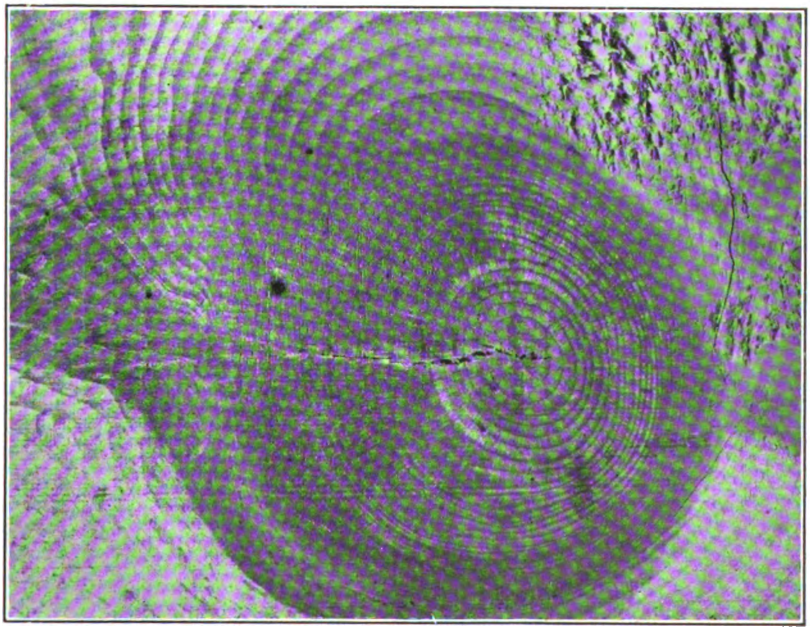


FIG. 7.—Large Knot.

PLATE III.
PROC. AM. SOC. TEST MATS.
STANDARD CLASSIFICATION OF STRUCTURAL TIMBER.

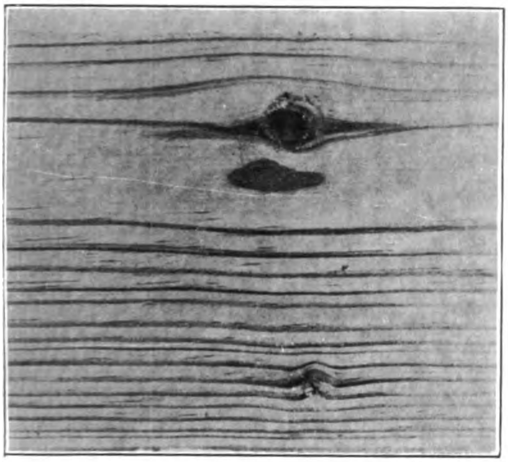


FIG. 5.—Pin Knot.

FIG. 8.—Spike Knot.

FIG. 9.—Pitch Pocket.

FIG. 10.—Pitch Streak.

that is, the coarse-grained fiber, usually termed "Spring wood," is not saturated with pitch, it shall not be considered a defect.

13. *Wane.*—Wane is bark, or the lack of wood from any cause, on edges of timbers.

14. *Shakes.*—Shakes are splits or checks in timbers which usually cause a separation of the wood between annual rings.

15. *Rot, Dote* and *Red Heart.*—Any form of decay which may be evident either as a dark red discoloration not found in the sound wood, or the presence of white or red rotten spots, shall be considered as a defect.

16. *Ring Shake.*—An opening between the annual rings.

17. *Through Shake.*—A shake which extends between two faces of a timber.

## III. STANDARD NAMES FOR STRUCTURAL TIMBERS.

1. *Southern Yellow Pine.*—Under this heading two classes of timber are used, (*a*) Longleaf Pine, (*b*) Shortleaf Pine.

It is understood that these two terms are descriptive of quality, rather than of botanical species. Thus, shortleaf pine would cover such species as are now known as North Carolina pine, loblolly pine, and shortleaf pine. "Longleaf Pine" is descriptive of quality, and if Cuban, shortleaf, or loblolly pine is grown under such conditions that it produces a large percentage of hard summer wood, so as to be equivalent to the wood produced by the true longleaf, it would be covered by the term "Longleaf Pine."

2. *Douglas Fir.*—The term "Douglas Fir" is to cover the timber known likewise as yellow fir, red fir, western fir, Washington fir, Oregon or Puget Sound fir or pine, norwest and west coast fir.

3. *Norway Pine*, to cover what is known also as "Red Pine."

4. *Hemlock*, to cover Southern or Eastern hemlock; that is, hemlock from all States east of and including Minnesota.

5. *Western Hemlock*, to cover hemlock from the Pacific coast.

6. *Spruce*, to cover Eastern spruce; that is, the spruce timber coming from points east of Minnesota.

7. *Western Spruce*, to cover the spruce timber from the Pacific coast.

8. *White Pine*, to cover the timber which has hitherto been known as white pine, from Maine, Michigan, Wisconsin and Minnesota.

9. *Idaho White Pine*, the variety of white pine from western Montana, northern Idaho, and eastern Washington.

10. *Western Pine*, to cover the timber sold as white pine coming from Arizona, California, New Mexico, Colorado, Oregon and Washington. This is the timber sometimes known as "Western Yellow Pine," or "Ponderosa Pine," or "California White Pine," or "Western White Pine."

11. *Western Larch*, to cover the species of larch or tamarack from the Rocky Mountain and Pacific coast regions.

12. *Tamarack*, to cover the timber known as "Tamarack," or "Eastern Tamarack," from States east of and including Minnesota.

13. *Redwood*, to include the California wood usually known by that name.

## AMERICAN SOCIETY FOR TESTING MATERIALS

PHILADELPHIA, PA., U. S. A.

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INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.

# STANDARD SPECIFICATIONS FOR YELLOW-PINE BRIDGE AND TRESTLE TIMBERS.

ADOPTED SEPTEMBER 1, 1910.

(To be applied to single sticks and not to composite members.)

### GENERAL REQUIREMENTS.

Except as noted, all timber shall be sound, sawed to standard size, square-edged and straight; shall be close-grained and free from defects, such as injurious ring shakes and cross grain, unsound or loose knots, knots in groups, decay, or other defects that will materially impair its strength.

*Standard Size of Sawed Timber.*—Rough timbers sawed to standard size shall mean that they shall not be over ¼ in. scant from the actual size specified. For instance, a 12 by 12-in. timber shall measure not less than 11¾ by 11¾ ins.

*Standard Dressing of Sawed Timber.*—Standard dressing shall mean that not more than ¼ in. shall be allowed for dressing each surface. For instance, a 12 by 12-in. timber after being dressed on four sides shall measure not less than 11½ by 11½ ins.

### STRINGERS.

*Standard Heart Grade. Longleaf Yellow Pine.*—Shall show not less than 85 per cent. heart on the girth anywhere in the length of the piece; provided, however, that if the maximum amount of

sap is shown on either narrow face of the stringer, the average depth of sap shall not exceed ½ in. Knots greater than 1½ ins. in diameter shall not be permitted at any section within 4 ins. of the edge of the piece; but knots shall in no case exceed 4 ins. in their largest diameter.

*Standard Grade. Longleaf and Shortleaf Yellow Pine.*—Shall be square-cornered, with the exception of 1 in. wane on one corner. Knots shall not exceed in their largest diameter one-fourth the width of the face of the stick in which they occur, and shall in no case exceed 4 ins. Ring shakes shall not extend over one-eighth of the length of the piece.

### CAPS AND SILLS.

*Standard Heart Grade. Longleaf Yellow Pine.*—Shall show not less than 85 per cent. heart on each of the four sides, measured across the sides anywhere in the length of the piece, and shall be free from knots over 2½ ins. in diameter.

*Standard Grade. Longleaf and Shortleaf Yellow Pine.*—Shall be square-cornered, with the exception of 1 in. wane on one corner, or ½ in. wane on two corners. Knots shall not exceed in their largest diameter one-fourth the width of the face of the stick in which they occur, and shall in no case exceed 4 ins. Ring shakes shall not extend over one-eighth of the length of the piece.

### POSTS.

*Standard Heart Grade. Longleaf Yellow Pine.*—Shall show not less than 75 per cent. heart on each of the four faces, measured across the sides anywhere in the length of the piece, and shall be free from knots over 2½ ins. in diameter.

*Standard Grade. Longleaf and Shortleaf Yellow Pine.*—Shall be square-cornered, with the exception of 1 in. wane on one corner, or ½ in. wane on two corners. Knots must not exceed in their largest diameter one-fourth the width of the face of the stick in which they occur, and shall in no case exceed 4 ins. Ring shakes shall not extend over one-eighth of the length of the piece.

### LONGITUDINAL STRUTS AND GIRTS.

*Standard Heart Grade. Longleaf Yellow Pine.*—One side shall show all heart, and the other side shall show not less than

85 per cent. heart, measured across the side anywhere in the length of the piece; shall be free from any large knots or other defects that will materially injure its strength.

*Standard Grade. Longleaf and Shortleaf Yellow Pine.*—Shall be square-edged and sound, and shall be free from any large knots or other defects that will materially injure its strength.

### LONGITUDINAL X-BRACES, SASH BRACES AND SWAY BRACES.

*Standard Heart Grade. Longleaf Yellow Pine.*—Shall show four square corners and not less than 80 per cent. heart on each of two faces, and shall be free from any large knots or other defects that will materially injure its strength.

*Standard Grade. Longleaf and Shortleaf Yellow Pine.*—Shall be square-cornered and sound, and shall be free from any large knots or other defects that will materially injure its strength.

### TIES AND GUARD RAILS.

*Standard Heart Grade. Longleaf Yellow Pine.*—Shall show one side all heart; the other side and two edges shall show not less than 75 per cent. heart, measured across the face anywhere in the length of the piece. Shall be free from any large knots or other defects that will materially injure its strength. Where surfaced, the remaining rough face shall show all heart.

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# STANDARD TEST FOR FIREPROOF FLOOR CONSTRUCTION.

ADOPTED AUGUST 15, 1908.

The test structure may be located at any place convenient to the applicant, where all the necessary facilities for properly conducting the test are provided.

The test structure may be constructed of walls of any material not less than twelve inches thick, properly buttressed on all sides.

The floor construction to be tested shall form the roof of the test structure.

At a height of not less than 2 ft. 6 in., nor more than 3 ft. above the ground level, a metal grate, properly supported, shall be provided, covering the whole inside area of the building.

In the walls below this grate level, draught openings shall be provided, as many as possible, furnishing openings with an aggregate area of not less than one square foot for every ten square feet of grate surface. Means for temporarily closing these openings should be provided.

In the wall, immediately above the grate level, a firing door, 3 ft. 6 in. by 5 ft. high, must be provided in the side of the building at right angles to the floor beams. A second door must be added when the span of the floor slab under test exceeds ten feet.

Flues should be supplied at each of the corners, and oftener in case of a test structure exceeding 250 sq. ft. of grate surface, with sufficient opening to insure a proper draught, securely supported and disposed at the sides of the structure in such

manner as not to rest on the floor under test. In no case should a flue area be less than 180 sq. ins.

The horizontal dimensions of the test structure will depend upon the number and the span of the systems under consideration. The clear span of the floor beams is to be 14 ft. The distance between floor beams, or span of slab, may be varied according to the design of the system to be tested, and should be as near as possible to usual practice. The underside of the construction under test must be not less than 9 ft. 6 in. nor more than 10 ft. above the grate level.

The construction to be tested should be designed for a working load of one hundred and fifty pounds per square foot, and no more. This load is to be uniformly distributed without arching effect, and is to be carried on the floor during the fire test.

The floor may be tested as soon after construction as desired, but within forty days. Artificial drying will be allowed if desired.

No plastering shall be applied to the underside of the floor construction under test.

The floor shall be subjected for four hours to the continuous heat of a fire of an average temperature of not less than 1700° F.; the fuel used being either wood or gas, so introduced as to cause an even distribution of heat throughout the test structure.

The heat obtained shall be measured by means of standard pyrometers, under the direction of an experienced person. The type of pyrometer is immaterial so long as its accuracy is secured by proper standardization. The heat should be measured at not less than two points when the main floor span is not more than 10 ft. and one additional point when it exceeds 10 ft. Temperature readings at each point are to be taken every three minutes. The heat determination shall be made at points directly beneath the floor so as to secure a fair average.

At the end of the heat test a stream of water shall be directed against the underside of the floor, discharged through a 1⅛-in. nozzle, under 60 pounds nozzle pressure, for ten minutes, the nozzle being held not more than 3 ft. from the firing door during the application of the water.

After the floor has sufficiently cooled the load on the same

shall be increased to six hundred pounds per square foot, uniformly distributed.

The test shall not be regarded as successful unless the following conditions are met: No fire or smoke shall pass through the floor during the fire test; the floor must safely sustain the loads prescribed; the permanent deflection must not exceed one-eighth inch for each foot of span in either slab or beam.

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# STANDARD TEST FOR FIREPROOF PARTITION CONSTRUCTION.

ADOPTED AUGUST 16, 1909.

The test structure may be located at any place convenient to the investigator, where all the necessary facilities for properly conducting the test are provided.

The test structure shall be of such design that the partition construction to be tested shall form at least one side of the structure. The other sides, roof, and foundations of the structure may be of any materials and design that will withstand and confine the fire within the test structure for the required time.

At a height of not less than 2 ft. 6 ins., nor more than 3 ft., above the ground level, a metal grate, properly supported, shall be provided, covering the whole inside area of the building.

In the walls below the grate level, draught openings shall be provided, as many as possible, furnishing openings with an aggregate area of not less than one square foot for every ten square feet of grate surface. Means for temporarily closing these openings shall be provided.

Immediately above the grate level, in one of the end walls of the structure, a firing door 3 ft. 6 ins. wide by 5 ft. high must be provided.

Flues shall be supplied at each of the corners, and more often for a test structure with more than 250 sq. ft. of grate surface, with sufficient opening to insure a proper draught. In no case shall a flue area be less than 180 sq. ins.

The size of the test structure will depend on the area of the

partition construction to be tested. In no case shall the partition construction under test be less than 9 ft. 6 ins. high, nor less than 14 ft. 6 ins. long. This entire area must be above the level of the grate bars, and, within such dimensions, must not be reinforced or braced in any manner other than is done as an inherent and essential part of the system of construction. The edges may be supported in any manner fairly representing the conditions of support in good practice.

The width of the test structure at right angles to the partition under test shall not be less than 9 ft.

The construction to be tested shall be subjected for two hours to the continuous heat of a fire, rising in temperature to 1700° F. by the end of the first half hour, and maintained at an average temperature of 1700° F. for the balance of the test; the fuel used being either wood, gas or oil, so introduced as to cause an even distribution of the heat throughout the test structure.

The temperature obtained shall be measured by means of standard pyrometers under the direction of an experienced person. The type of pyrometer is immaterial so long as its accuracy is secured by proper standardization. The temperature should be measured near the center of the test structure about 6 ins. below the roof or ceiling, and also at the center of each partition under test about 7 ft. above the grate level. In case the partition under test is more than 15 ft. long, additional pyrometers shall be used, symmetrically disposed and not more than 12 ft. apart. Temperature readings at each point shall be taken every three minutes, and the average used as the controlling temperature.

At the end of the heat test, a stream of water shall be directed against the construction under test, discharged through a 1⅛-in. nozzle, under 30 lbs. nozzle pressure, for two and one-half minutes, the nozzle being held within 2 ft. of the firing door and the hose stream being played backward and forward over the entire surface of the partition under test.

The test shall not be regarded as successful unless the following conditions are met: No fire or smoke shall pass through the partition during the fire test; the partition must safely sustain the pressure of the hose stream; the partition must not warp or bulge, or disintegrate under the action of the fire or water to such an extent as to be unsafe.

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## STANDARD ABRASION TEST FOR ROAD MATERIAL.

ADOPTED AUGUST 15, 1908.

This well-known test is similar in almost all respects to the Deval abrasion test of the French School of Roads and Bridges. It has been used since 1878, and is entirely satisfactory for the purpose for which it was designed.

### ABRASION TEST.

The machine shall consist of one or more hollow iron cylinders; closed at one end and furnished with a tightly fitting iron cover at the other; the cylinders to be 20 cm. in diameter and 34 cm. in depth, inside. These cylinders are to be mounted on a shaft at an angle of 30° with the axis of rotation of the shaft.

At least 30 lbs. of coarsely broken stone shall be available for a test. The rock to be tested shall be broken in pieces as nearly uniform in size as possible, and as nearly 50 pieces as possible shall constitute a test sample. The total weight of rock in a test shall be within 10 grams of 5 kilograms. All test pieces shall be washed and thoroughly dried before weighing. Ten thousand revolutions, at the rate of between 30 and 33 to the minute, must constitute a test. Only the percentage of material worn off which will pass through a 0.16 cm. (1-16 inch) mesh sieve shall be considered

in determining the amount of wear. This may be expressed either as the percentage of the 5 kilograms used in the test, or the French coefficient, which is in more general use, may be given; that is, coefficient of wear $= 20 \times \frac{20}{W} = \frac{400}{W}$. "W" is the weight in grams of the detritus under 0.16 cm. (1-16 inch) in size per kilogram of rock used.

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# STANDARD TOUGHNESS TEST FOR MACADAM ROCK.

ADOPTED AUGUST 15, 1908.

In the consideration of macadam road materials, toughness is understood to mean the power possessed by a material to resist fracture by impact.

In testing macadam rocks under impact, it has been found best to apply a number of blows of successively increasing energy and note the blow causing failure. The following test involving this principle is, therefore, recommended for determining the toughness of rock for macadam road building.

## TOUGHNESS TEST.

1. Test pieces may be either cylinders or cubes, 25 mm. in diameter, and 25 mm. in height, cut perpendicular to the cleavage of the rock. Cylinders are recommended as they are cheaper and more easily made.

2. The testing machine shall consist of an anvil of 50 kilograms weight, and placed on a concrete foundation. The hammer shall be of 2 kilograms weight, and dropped upon an intervening plunger of 1 kilogram weight, which rests on the test piece. The lower or bearing surface of this plunger shall be of spherical shape having a radius of 1 cm. This plunger shall be made of hardened steel, and pressed firmly upon the test piece

by suitable springs. The test piece shall be adjusted, so that the center of its upper surface is tangent to the spherical end of the plunger.

3. The test shall consist of a 1-cm. fall of the hammer for the first blow, and an increased fall of 1 cm. for each succeeding blow until failure of the test piece occurs. The number of blows necessary to destroy the test piece is used to represent the toughness, or the centimeter-grams of energy applied may be used.

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## STANDARD METHODS OF TESTING.

ADOPTED SEPTEMBER 1, 1910.

### I. METHODS FOR TENSILE TESTS OF METALS.

1. Information obtained from the various laboratories in which tensile tests are made shows that in many cases the forms and dimensions of specimens as recommended by the American Society for Testing Materials are in use, and that in other cases these forms and dimensions most nearly reconcile the differences that exist between the various forms employed.

2. It is therefore recommended that the selection of specimens, and their forms and dimensions, shall conform to the specifications for each material, as are now adopted by the American Society for Testing Materials.

3. It is believed that the distance between the end of gauge length and beginning of shoulders, as prescribed in the standard specifications of the American Society for Testing Materials, is ample to avoid interference with proper elongation, and no grounds are found for recommending any change.

4. All information obtained confirms the investigations of Committee O (since dissolved), to the effect that within the limits of speed common in commercial testing, the effect of different speeds on results is not of observable moment; that is, within ranges of speed varying from 1 to 6 ins. per minute.

5. Beyond these limits, however, very rapid loading influences the ultimate strength, which increases with the speed. Whether the elongation is increased or decreased depends somewhat upon

the nature of the material, though in general very rapidly applied loads will increase the stretch, owing to the elongation occurring over the whole body of the specimen, rather than chiefly at the point of reduction, which is more marked with slowly applied loads.

6. Within the limits of speed customary in determining the modulus of elasticity, it does not appear that the rate of loading influences the value obtained, but whether this value be determined by an autographic attachment to the machine, or by an extensometer on the specimen, it is desirable that the loading be not too rapid, or not over 0.05 in. per minute, to avoid impairing the accuracy of the sensitive devices employed.

7. In determining the modulus of elasticity, the elastic limit (the load at which stress and strain are no longer proportional), and the least load producing a given permanent set, it is considered necessary that the extensometer be attached to two sides of the specimen, to compensate for unequal elongation, for improper holding, or for any slight bending that may exist in the specimen.

8. All authorities seem to regard it as desirable to take the stretch on the two sides of the test piece, and most extensometers provide for so doing.

9. The greatest accuracy is required in determining the modulus of elasticity, since small errors in measuring elongation are of considerable consequence in the result.

10. Since the modulus is determined for points well within the elastic limit, the total elongation to be measured is much smaller than at the elastic limit.

11. The elastic limit should be determined with great care, but any inaccuracy will cause less proportionate error than in the case of the modulus. The yield point, being less well defined, cannot be so closely determined, and it is believed that in most cases the use of dividers instead of an extensometer will give sufficiently accurate results.

12. It is considered undesirable in accurate determinations of the modulus of elasticity to use a shorter gauge length than 8 ins. It is evident that the greater the total elongation measured, the less will be the error due to inaccuracy of the reading, and the accuracy thus appears to increase directly as the gauge length.

13. That the difference between short and long gauge lengths, has a greater influence in affecting results than other factors (personal error, inaccuracy of the testing machine, etc.), is shown by the closely agreeing readings obtained with the greater lengths.

14. The effect of improper methods of holding specimens could not be established from the results of actual tests. The result of improper methods of gripping materials of low stretch, such as cast iron, is well known, and it is probable that in material of a softer nature, the effect is largely local and does not extend to the portion of the specimen within the gauge marks.

*Conditions to Ensure Correct Testing Machines.*—1. It is recommended that in machines on which specimen tests are made, whether the power be applied hydraulically or by means of screws and gears, the load be measured by a separate system of levers and knife edges, or by a method similar to that employed in the Emery testing machines at the Watertown Arsenal.

2. All knife edges shall be kept sharp, and free from oil and dirt, and the machine shall be sensitive to a variation in load of one two-hundred-and-fiftieth of the load carried. Design and workmanship on testing machines shall be good, and they shall be calibrated at least once every six months by the following method:

*Calibration of Testing Machines.*—1. Test for accuracy by loading the weighing table with standard weights, and compare the actual weight at each addition with the reading of the beam. If the table is uniformly loaded in this manner with the full amount of weights that it will accommodate, the proportionality of the levers and the weighing beam can be successfully established. This relation, in a properly designed machine, will remain constant for all loads, but as a further test for sensitiveness under greater loads than can be accommodated in this manner, the following procedure is recommended:

2. Place in the machine a tension bar of such cross section that the maximum capacity will not stress it to the elastic limit. Stress this bar to various extents through the full range of the machine, and at each load balance the beam and place upon the weighing table standard weights of 100 lbs. A weight one two-hundred-and-fiftieth of the total load on the machine should produce a readable movement of the beam.

3. Where evidence of the accuracy of the machine over its

whole range is desired, a known load may be applied by means of an extensometer and calibrated bar, whose modulus of elasticity has been determined with exactness.

4. It is recommended that a device be adopted conforming to the following requirements, in which the extensometer and bar are permanently attached to each other:

(*a*) The bar shall be of high elastic limit material, and of such cross section that this limit will be well above the total capacity of the machine on which it is to be used.

(*b*) This bar shall be annealed or otherwise treated so as to eliminate internal or unequal stress in the material, and to ensure its elastic modulus being uniform for successive tests.

(*c*) The extensometer shall be permanently attached to the bar, and shall measure the elongation on two opposite sides.

(*d*) The extensometer shall be preferably of the indicating or direct-reading type, and shall indicate to ten-thousandths of an inch or less.

(*e*) The method of securing the bar in the drawheads of the machine shall be positive and without slip, and shall ensure its axial location.

(*f*) The length of the bar measured by the extensometer shall be sufficient, that the smallest extensometer division will correspond to a difference in loading of 100 lbs. or less.

(*g*) The extensometer shall be protected from injury by a permanently attached case with cover removable for reading the scale.

(*h*) The apparatus shall be plainly marked with the maximum load that can be safely applied without injury.

(*i*) The apparatus shall itself be calibrated either by the United States Bureau of Standards, or in a manner that will ensure equally trustworthy results.

*Methods of Gripping Test Specimens.*—1. It is recommended that for specimens of rolled material, serrated grips, flat and

V-shaped, be adopted, the former for rectangular and the latter for round specimens. Serrated grips with curved faces appear to have no advantage, and to cause crushing of the material.

2. Wedges with ball and socket do not seem to be necessary, and for commercial testing their use has been generally discontinued.

3. Specimens of turned form, with threaded ends, should be secured in such a manner that side bending stresses are avoided.

4. It is considered important for correct results that the specimen be located in the exact center of the heads, and to better secure this condition, the openings in the heads should be lined up with each other by means of a plumb-bob and be tested for parallelism with a spirit level. Each pair of packing pieces and wedges that are to be used together in the same head should correspond exactly in thickness and other dimensions, and the wedges should be inserted an equal distance when the specimen is in place.

*Selection and Preparation of Specimen.*—1. Specimens representative of steel castings may be cut from the bottom of a sink head or riser, or from a coupon attached to the casting. In either case the part from which the specimen is taken should be relatively large in proportion to the size of the casting and should be annealed with it.

2. Workmanship on specimens shall be of the most careful nature, and surfaces should be free from nicks and tool marks. All wire edges should be removed and corners generously rounded.

3. If specimens of rolled material are sheared in the rough from sections, at least $\frac{1}{8}$ in. of the material should be removed from the sheared edges in machining.

*General Requirements for the Measuring of Elongation.*—In determining the modulus of elasticity and the elastic limit, it is recommended that when practicable the elongation be measured in a length not less than 8 ins., and that the following requirements be provided for:

(*a*) The specimen shall be round in section, finished as smooth as possible, and shall be provided with threaded ends for attachment to the draw-heads of the machine.

(*b*) The specimen shall be placed in the exact center of the heads, and be secured in some positive manner, so that slip and side bending stresses do not occur.

(*c*) The extensometer should be of a type to measure the elongation on opposite sides of the specimen, and when adjusted the points of attachment should be exactly opposite each other.

(*d*) It should read to ten-thousandths of an inch or less.

(*e*) It should be of such a design that no change of zero will occur upon release of the load in determining the real elastic limit.

(*f*) The load shall be applied so slowly that simultaneous readings of elongation and load can be obtained with certainty.

(*g*) The testing machine shall have previously been calibrated for accuracy and sensitiveness, and heads lined up and made parallel.

## II. METHODS FOR COMPRESSIVE TESTS OF METALS.

1. The test specimen shall be a cylinder having plane ends truly normal to its axis.

Only two replies from testing laboratories mention cubes. A cylindrical specimen will usually be cheaper to prepare than a cube. The stresses are probably less uniformly distributed over a square than over a circular section, owing to the influence of the corners, this being especially the case with the internal shearing stresses which accompany the compression.

2. The diameter of the specimen shall be not less than 1 in. nor greater than 1.13 ins. A specimen 1 in. in diameter is to be preferred.

The range of diameter mentioned in the replies from testing laboratories is from 1 in. to 1.129 ins. A diameter of 1.1284 ins. gives a section area of 1 sq. in.

3. The length of the specimen should be between 2.5 and 4 diameters.

Two testing laboratories use a length of 1 diameter, one a length of from 1.5 to 2 diameters, one a length of 2.6 diameters, and one a length of 10.5 diameters. It is believed that a length less than 2.5 diameters is

not sufficient for the internal shear to be properly developed, and that such short lengths give a fictitious strength owing to the friction of the bearing plates of the machine, which causes the specimen to assume a barrel-like form.

4. No bedding should be used for the ends of the specimen.

Only one reply favors bedding. It is known by general experience that bedding modifies the breaking load and that different kinds of bedding have different influences.

5. The bearing blocks which transmit the pressure from the testing machine should be truly normal to the plane ends of the specimen. To secure this, one of the blocks should be provided with a hemispherical bearing which can turn freely.

These requirements seem essential in order that the load may not be eccentrically applied to the specimen, and are generally recommended in the replies from testing laboratories.

6. The speed of compression should be slow, not exceeding 0.1 in. per minute. Near the elastic limit and yield point the load should be increased very slowly.

A lower speed than that stated might be advisable if permitted by the testing machine. Evidently a higher speed may be allowed with a long specimen than with a short one.

7. For determining modulus of elasticity, the linear compression of the specimen should be observed by a precise compressometer which is attached to the specimen and does not touch the bearing blocks of the machine. Readings of the compressometer should be taken for three loads, the first at about one fourth, the second at about one half, and the third at about three fourths of the elastic limit.

It is believed that these measurements are sufficient for most commercial work. Nothing is said about the release of the specimen from load, since opinions differ as to its advisability.

8. To determine the elastic limit, several readings of the compressometer should be taken as that limit is approached for load increments of 1,000 lbs. per sq. in.

This requirement seems sufficient to determine the proportional elastic limit for materials in which such a limit exists. It does not seem wise to require the first permanent set to be observed for ordinary commercial work.

9. The yield point is to be noted as corresponding to that load for which the compressometer shows a linear compression without an increase in load. In the absence of a compressometer this point may be noted, for ductile materials, by the drop of the scale beam.

This requirement corresponds to the usual practice of testing laboratories. It is regarded as important that the term "elastic limit" should not be used to designate the yield point.

10. Measurements for the modulus of elasticity, elastic limit, and yield point may be made, if desired, on a specimen ranging in length from 10 to 15 diameters.

This clause is inserted because it may often be difficult to apply a compressometer in a length shorter than 4 ins.

11. The record of the test should mention any phenomena observed near the elastic limit and yield point. The manner of final failure should also be noted when the test is carried to this limit.

This requirement furnishes data for comparing the behavior of brittle and ductile metals near critical points of molecular change.

## III. METHODS FOR METALLOGRAPHIC TESTS OF METALS.

For general work the following notes are submitted:

*Microscopic Examination.*—For unhardened iron and steel, the following process has given satisfaction:

1. After polishing, examine under a magnification of 50 to 150 diameters. Look for slag or cinder in wrought iron, manganese sulphide, etc., in steel,* and size and shape of graphite in cast iron.

2. Etch with a saturated solution of picric acid in alcohol for 15 seconds. This reveals the pearlite† by turning it darker than the accompanying ferrite or cementite. In wrought iron, any pearlite present shows up, and the general appearance will sometimes show whether the material was puddled, etc., or made from reheated scrap. Those who wish to bring out the ferrite grains

* Arnold and Waterhouse, *Jour. Iron and Steel Inst.*, 1903, I, 136; E. F. Law, *Jour. Iron and Steel Inst.*, 1907, II, 94; Fay, *Proc. Am. Soc. Test. Mat.*, 1908, VIII, 74.

† Igevsky, *Rev. de Met.*, II; Lejeune, *Rev. de Met.*, III, 426.

can do so easily and quickly by etching with nitric acid. To this end, nitric acid of 1.42 specific gravity should be diluted with either:

(*a*) 90 parts by volume of water to 10 of acid,
(*b*) 75 " " " " " " 25 " " or preferably
(*c*) 96 " " " " amyl alcohol to 4 of acid.

3. Near the eutectoid point, viz., 0.6 to 1.0 per cent. carbon, it is often difficult to distinguish between thin envelopes of ferrite and cementite. This difficulty can be overcome by etching with a solution of sodium picrate, which turns cementite dark brown or black but does not color the other constituents. The solution is made by adding 2 parts of picric acid to 98 parts of a solution containing 25 per cent. of caustic soda, and is used at 100° C.*

In order to interpret the results of such an etching, they should be compared with standard etched specimens.

In the case of hardened and tempered steel the indications are less decisive than in the case of unhardened steel, probably because the former class has been studied less than the latter. Coarse grain, segregation of constituents, presence of oxide, etc., are all signs of bad material. For etching use a solution of 4 per cent. nitric acid, specific gravity 1.42, in 96 of amyl alcohol. The time needed has to be found by trial in each case. Hence etch for 5 seconds, examine, re-etch if necessary,† etc.

*Macroscopic Examination.*—This method shows up defects due to segregation, blowholes, piping, and the like, and when used in connection with microscopic examination yields valuable information. A section is cut with a saw, filed smooth, and polished with No. 0 and No. 00 emery paper; it is then ready for etching.

Quite a number of etching reagents have been used‡ to develop the structure. Whichever solution is chosen, the specimen is first carefully washed with a strong caustic potash solution, well rinsed under the tap, and then immersed in the etching solution. The following may be mentioned:

* Kourbatoff, *Rev. de Met.*, III, 648.

† Kourbatoff, *Rev. de Met.*, III, 648; Lejeune, *Rev. de Met.*, III, 426; Heyn, Mitt. aus dem König. Materialsprüf. Gross-Lichterfelde, West, 1906, 29.

‡ Fremont, *Rev. de Met.*, V, 669. Ast. Internat. Assoc. Test. Materials, 1907. IVth Congress. Problem 2.

(*a*) Freshly prepared solution of 20 grams of I and 30 grams of KI, in 1,000 grams of water.

(*b*) Dilute HCl or $H_2SO_4$ up to 30 per cent. acid, using the 1.2 and 1.84 specific gravity respectively.

(*c*) Nitric acid, from 10 to 30 per cent. of the 1.42 specific gravity* acid in 90 to 70 per cent. of water.

(*d*) Concentrated HCl, specific gravity 1.2.

(*e*) A solution of 10 or 12 parts of double copper-ammonium chloride in 90 or 88 parts of water.

To bring out the structure of wrought iron rapidly, (*d*) is used, while (*c*) or (*b*) will bring it out more slowly.

For steel, first etch with (*a*), which shows up the segregation of carbon very well. Take care not to over-etch; 5 seconds is enough for some materials. To show up the impurities and the segregation of MnS, slag, etc., (*d*) acts quickly, but (*b*) gives better results though taking longer.

Some prefer light e ching, say after 1 or 2 minutes, but an older method is to etch with (*b*) very deeply, indeed to a depth so great that several hours may be needed to reach it. In this way the segregation of the carbon and the impurities like slag and MnS are shown simultaneously. A picture of the object thus etched can be had by treating it like an engraving, i. e., inking it with printer's ink, and printing on white paper directly from it. A common letter-copying press is convenient for this printing.

* Stead, *Proc. Cleveland Inst. of Engrs.*, Sept., 1906, p. 3.

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1904. BREGOWSKY, IVAN M. Metallurgist, Crane Company, 51 Judd Street, Chicago, Ill.

1906. *BRIGHT, H. DE H. Manager, Spring Department, Standard Steel Works, 1008 Harrison Building, Philadelphia, Pa.

1899. BROADHURST, W. H. Chemist, Department of Public Works, Municipal Building, Brooklyn, N. Y.

1909. *BROBSTON, JOSEPH. Treasurer, Dexter Portland Cement Company, Nazareth, Pa.

1905. BROWN AND COMPANY, INCORPORATED. Wayne Iron and Steel Works. James Neale, Secretary, Pittsburg, Pa.

1907. BROWN, CHARLES S. Professor of Mechanical Engineering, Vanderbilt University, Nashville, Tenn.

1908. BROWN, E. Assistant Professor of Applied Mechanics, McGill University, Montreal, Canada.

1906. BROWN HOISTING MACHINERY COMPANY, THE. Alexander E. Brown, Vice-President and General Manager, Cleveland, O.

1904. *BROWN, JOHN G. 809 North Forty-first Street, Philadelphia, Pa.

1906. ‡BROWN, RICHARD P. 311 Walnut Street, Philadelphia, Pa.

1908. BROWN UNIVERSITY, DEPARTMENT OF MECHANICAL ENGINEERING. Wm. H. Kenerson, Associate Professor of Mechanical Engineering, Providence, R. I.

1905. BROWN, WILLIAM L. With George M. Newhall Engineering Company, 136 South Fourth Street, Philadelphia, Pa.

1906. BROWNE, ARTHUR L. Consulting Chemist, 213 Courtland Street, Baltimore, Md.

1910. BROWNE, FRANK A. Assistant Engineer, Isthmian Canal Commission, Culebra, Canal Zone.

1903. *BRUNNER, JOHN. Assistant General Superintendent, North Works, Illinois Steel Company, Chicago, Ill.

1910. *BUCH, N. W. Superintendent, Safety Armorite Conduit Company, West Pittsburg, Pa.

1909. BUCK, D. M. Chief Chemist, American Sheet and Tin Plate Company, McKeesport, Pa.

1909. *‡BUCK, LUCIEN. Civil and Consulting Engineer, Canton, N. C.

1905. BUCK, R. S. Sanderson and Porter, 52 William Street, New York, N. Y.

1903. BUCKLEY, E. R. Mining Geologist, Rolla, Mo.

ELECTED.

1908. BUDD, RALPH. Chief Engineer, Panama Railroad, Cristobal, Canal Zone.

1910. BUFFALO, ROCHESTER AND PITTSBURG RAILWAY COMPANY. H. F. Burnham, Chemist and Engineer of Tests, DuBois, Pa.

1908. *BULL, R. A. General Superintendent, Commonwealth Steel Company, Granite City, Ill.

1908. BULLITT, W. C. Coal Merchant, Arcade Building, Philadelphia, Pa.

1904. *BUNNELL, F. O. Engineer of Tests, Chicago, Rock Island and Pacific Railway, Chicago, Ill.

1902. BURDETT, F. A. Consulting Engineer, 29 West Thirty-fourth Street, New York, N. Y.

1910. BUREAU OF SCIENCE. Miss Mary Polk, Librarian, Manila, P. I.

1910. BURGESS, CHARLES F. Professor of Chemical Engineering, University of Wisconsin, Madison, Wis.

1906. BURNAP, ARTHUR M. Room 403, Wood Building, 400 Chestnut Street, Philadelphia, Pa.

1899. *BURR, WILLIAM H. Professor of Civil Engineering, Columbia University, New York, N. Y.

1908. BURROWS, CHARLES W. Assistant Physicist, Bureau of Standards, Washington, D. C.

1908. BUSH, B. F. President, Davis Coal and Coke Company, Continental Building, Baltimore, Md.

1906. *BUSH, HAROLD M. Mechanical Engineer, 69 North Fourth Street, Columbus, O.

1908. BUSHNELL, FRED N. Mechanical Engineer, 147 Milk Street, Boston, Mass.

1905. BUSS, EDWARD A. Consulting Engineer, 85 Water Street, Boston, Mass.

1910. BUTLER, GEORGE. Master Painter, 1640 Market Street, Philadelphia, Pa.

1903. *BUZZI, P. D. Jefe del Laboratorio de Obras Publicas, Arsenal, Havana, Cuba.

1899. *CAMBRIA STEEL COMPANY. George E. Thackray, Structural Engineer, Johnstown, Pa.

1907. ‡CAMPBELL, CHARLES M. 128 Garvine Avenue, Elyria, O.

1908. *CAMPBELL, H. H. Metallurgical Engineer, The Pennsylvania Steel Company, Girard Building, Philadelphia, Pa.

ELECTED.

1903. *CAMPBELL, WILLIAM. Adjunct Professor of Metallography, School of Mines, Columbia University, New York, N. Y.

1909. *CANADIAN PORTLAND CEMENT COMPANY, THE. F. G. B. Allen, General Manager, 506 Temple Building, Toronto, Ontario, Canada.

1906. CANALS, I. A. Civil Engineer, Post Office Box 436, San Juan, Porto Rico.

1898. *CAPP, JOHN A. Engineer, Testing Laboratory, General Electric Company, Schenectady, N. Y.

1910. CARBON STEEL COMPANY. Harry W. Fennill, Assistant General Sales Manager, 30 Church Street, New York, N. Y.

1910. *CARD, W. J. Cement Inspector, United States Reclamation Service, 408 Commonwealth Building, Denver, Colo.

1906. CARMODY, JOHN M. Inspector, Joseph T. Ryerson and Son, Sixteenth and Rockwell Streets, Chicago, Ill.

1908. CARNAHAN, R. B., JR. General Superintendent, American Rolling Mill Company, Middletown, O.

1910. CARNEGIE, ANDREW. 2 East Ninety-first Street, New York, N. Y.

1908. *CARNEGIE LIBRARY. Schenley Park, Pittsburg, Pa.

1898. CARNEGIE STEEL COMPANY. W. A. Bostwick, Metallurgical Engineer, Pittsburg, Pa.

1903. *CARNEY, F. D. Assistant Superintendent, The Pennsylvania Steel Company, Steelton, Pa.

1908. CARPENTER, A. W. Engineer of Structures, New York Central and Hudson River Railroad Company, Grand Central Station, New York, N. Y.

1909. CARPENTER, F. B. Chief Chemist, Virginia-Carolina Chemical Company, Richmond, Va.

1902. CARPENTER, LOUIS G. Professor of Civil and Irrigation Engineering, and Director of Experiment Station, Fort Collins, Colo.

1895. CARPENTER, ROLLA C. Professor of Experimental Engineering, Cornell University, 31 Eddy Street, Ithaca, N. Y.

1903. *†CARPENTER STEEL COMPANY, THE. J. H. Parker, Metallurgist, Reading, Pa.

1907. CARPENTER, WILLIAM M. Vice-President, Walworth and Neville Manufacturing Company, 1505 Heyworth Building, Chicago, Ill.

ELECTED.

1903. CARTLIDGE, C. H. Bridge Engineer, Chicago, Burlington and Quincy Railroad, 209 Adams Street, Chicago, Ill.

1906. CASE SCHOOL OF APPLIED SCIENCE, DEPARTMENT OF CIVIL ENGINEERING. F. H. Neff, Professor of Civil Engineering, Cleveland, O.

1908. *CATHCART, ROBERT. Specialist on Concrete Coatings, Glidden Varnish Company, Cleveland, O. *For Mail:* 2247 East Ninety-third Street, Cleveland, O.

1902. *CENTRAL IRON AND STEEL COMPANY. James B. Bailey, Treasurer and General Manager, Harrisburg, Pa.

1905. CHAMBERLAIN, PAUL R. Chemist, Dewey Portland Cement Company, Dewey, Okla.

1910. CHAMBERLIN, A. B. Road Oil Department, Indian Oil Company, First National Bank Building, Cincinnati, O.

1905. CHAMPION, E. C. Superintendent, Kansas Portland Cement Company, Iola, Kan.

1907. CHANDLER, B. L. Treasurer, Beckwith-Chandler Company, 201 Emmett Street, Newark, N. J.

1907. CHARLS, G. H. Assistant Secretary, The American Rolling Mill Company, Middletown, O.

1910. *‡CHATER, W. H. Department of Plant Maps, American Telephone and Telegraph Company, New York, N. Y. *For Mail:* Hotel Hastings, 197 Fulton Street, Brooklyn, N. Y.

1904. CHEESMAN, FRANK P. Cheesman and Elliot, Owners of National Paint Works, 100 William Street, New York, N. Y.

1910. CHEN, W. F. Livingstone Hall, Columbia University, New York, N. Y.

1908. CHESTER, M. E. Assistant Manager, Goodyear Rubber Insulating Company, 105 East One Hundred and Thirty-first Street, New York, N. Y.

1910. ‡CHILDS, WILL P. Designer, Rider-Lewis Motor Company, 401 West Tenth Street, Anderson, Ind.

1909. *‡CHILES, G. S. Motive Power Inspector, Lake Shore and Michigan Southern Railway, 944 Mars Avenue, Collinwood, O.

1905. CHRISTIAN, EDMUND. Manager, Norfolk Creosoting Company, Buell, Va.

1907. CHRISTIE, ALEXANDER J. Engineer of Tests, American Bridge Company, Ambridge, Pa.

ELECTED.

1898. *CHRISTIE, JAMES. (*Member of Executive Committee*). Mechanical Engineer, 100 Rochelle Avenue, Wissahickon, Philadelphia, Pa.

1910. *CHURCH, JOHN A. Mining Engineer, 15 William Street, New York, N. Y.

1907. CHURCH, SUMNER R. American Coal Products Company, 17 Battery Place, New York, N. Y.

1900. *CHURCHILL, CHARLES S. Chief Engineer, Norfolk and Western Railway, Roanoke, Va.

1909. *CHURCHWARD, ALEXANDER. Consulting Engineer, 30 Church Street, New York, N. Y.

1906. CINCINNATI CHAPTER, AMERICAN INSTITUTE OF ARCHITECTS. A. O. Elzner, Secretary, 608 Johnston Building, Cincinnati, O.

1905. *CIVIL ENGINEERS' CLUB OF CLEVELAND, THE. Joseph C. Beardsley, Secretary, 718 Caxton Building, Cleveland, O.

1905. CLAPP, WILFRED A. Civil Engineer, United States Quartermaster's Department, 103 Sherman Street, Portland, Me.

1908. *CLARK, DYER O. Vice-President and General Manager, The Union Pacific Coal Company, Omaha, Neb.

1907. CLARK, EDWIN. Chief of Bureau of Building Inspection, 317 City Hall, Philadelphia, Pa.

1900. *CLARK, F. H. General Superintendent of Motive Power, Chicago, Burlington and Quincy Railroad, 209 Adams Street, Chicago, Ill.

1910. ‡CLARK, W. T. Inspector of Materials, care of Engineer of Tests, Chicago, Rock Island and Pacific Railroad, Chicago, Ill.

1905. CLARKE, D. D. Civil Engineer, Water Board, City Hall, Portland, Ore.

1910. *CLARKE, E. A. S. President, Lackawanna Steel Company, 2 Rector Street, New York, N. Y.

1904. CLARKSON MEMORIAL SCHOOL OF TECHNOLOGY, THOMAS S. William S. Aldrich, Director, Potsdam, N. Y.

1910. ‡CLAY, T. F., JR. Material Inspector, Lake Shore and Michigan Southern Railway, Collinwood, O.

1908. CLEARFIELD CLAY WORKING COMPANY. Manufacturers of Paving Brick. R. S. Winslow, Secretary, Clearfield, Pa.

1905. CLEMENTS, FRANK O. Chemist, National Cash Register Company, Dayton, O.

ELECTED.

1904. CLIFTON, CHARLES H. First Assistant, Philadelphia Municipal Testing Laboratory, 318 City Hall, Philadelphia, Pa.

1907. CLINE, McGARVEY. Director, Forest Products Laboratory, United States Department of Agriculture, Madison, Wis.

1909. COBB, ERNEST B. Chemist, Standard Oil Company, 26 Broadway, New York, N. Y.

1905. COE, EDWARD K. Engineer of Highways and Bridges, St. Louis County, 205 Court House, Duluth, Minn.

1909. COE, THEODORE IRVING. Architect, 100 William Street, New York, N. Y.

1899. *COLBY, ALBERT LADD. Consulting Engineer, and Iron and Steel Metallurgist, 447 Lehigh Street, South Bethlehem, Pa.

1899. COLBY, J. ALLEN. Inspecting Engineer, Witherspoon Building, Philadelphia, Pa.

1910. COLE, WINTHROP. Mechanical Engineer, Engineering Experiment Station, United States Naval Academy, Annapolis, Md.

1900. *COLORADO FUEL AND IRON COMPANY. J. B. McKennan, Manager, Minnequa Plant, Pueblo, Colo.

1908. COLUMBIA STEEL AND SHAFTING COMPANY. A. A. Kealey, Sales Manager, P. O. Box 1595, Pittsburg, Pa.

1909. *COMEY, ARTHUR M. Director, Eastern Laboratory, Drawer 424, Chester, Pa.

1909. COMMONWEALTH-EDISON COMPANY. P. Junkenfeld, Assistant to Second Vice-President, 139 Adams Street, Chicago, Ill.

1910. CONARD, W. R. Inspecting Engineer, 322 High Street, Burlington, N. J.

1905. ‡CONDIT, E. A., JR. Inspector, Continuous Rail-Joint Company, 520 Summer Street, Newark, N. J.

1900. CONDRON, T. L. Consulting Engineer, 1442 Monadnock Building, Chicago, Ill.

1904. CONLIN, FREDERICK. President, Samuel L. Moore and Sons, Elizabethport, N. J. *For Mail:* 835 Kensington Avenue, Plainfield, N. J.

1906. CONOVER, H. SPENCER. Cement Inspector, Cementon, Pa.

1904. *CONRADSON, P. H. Chief Chemist, Galena Signal Oil Company, Franklin, Pa.

ELECTED.

1908. CONSOLIDATED GOLD FIELDS OF SOUTH AFRICA, LIMITED. R. G. Fricker, Joint Manager, Box 1167, Johannesburg, Transvaal.

1907. CONSOLIDATED GOLD FIELDS OF SOUTH AFRICA, LIMITED, INTELLIGENCE DEPARTMENT. Box 1167, Johannesburg, Transvaal.

1905. CONVERSE, W. A. Directing Chemist, Dearborn Drug and Chemical Works, 227–234 Rialto Building, Chicago, Ill.

1906. COOK, D. S. Superintendent, Speed Mills, Louisville Cement Company, Sellersburg, Ind.

1903. COOK, EDGAR S. President, Warwick Iron and Steel Company, Pottstown, Pa.

1910. *COOK, H. E. Lieutenant, United States Navy, Inspector of Ordnance and Engineering Material, Bethlehem Steel Works, South Bethlehem, Pa.

1909. COOPER, FRED G. W. United States Naval Station, Honolulu, H. I.

1910. *COOPER, JAMES B. Superintendent, Calumet and Hecla Smelting Works, Hubbell, Mich.

1907. COOPER, WILLIAM A. Superintendent, Schuylkill Iron Works, Alan Wood Iron and Steel Company, Conshohocken, Pa.

1909. CORLISS, W. J. Mechanical Engineer, 516 Monmouth Street, Jersey City, N. J.

1906. *CORNELL UNIVERSITY LIBRARY. George W. Harris, Librarian, Ithaca, N. Y.

1909. CORP, CHARLES I. Assistant Professor of Mechanical Engineering, Lawrence, Kan.

1909. *CORSE, W. M. Works Manager, Lumen Bearing Company, Sycamore and New York City Belt Line, Buffalo, N. Y.

1910. CORSON, CHARLES E. Metallurgist, Railway Steel-Spring Company, 1818 Ligonier Street, Latrobe, Pa.

1899. *CORTHELL, E. L. Civil Engineer, 149 Broadway, New York, N. Y.

1902. COSBY, SPENCER. Captain, Corps of Engineers, United States Army, care of War Department, Washington, D. C.

1906. *COWAN, GEORGE P. Assistant Engineer, Department of Engineering and Public Works, Manila, P. I.

1903. COWEN, HERMAN C. Superintendent, Catskill Cement Company, Smith Landing, Greene County, N. Y.

ELECTED.

1908. *CRANE COMPANY. Manufacturers of Valves and Fittings. John B. Berryman, Assistant Secretary, Chicago, Ill.

1906. ‡CRAWFORD, D. F. General Superintendent, Motive Power, Pennsylvania Railroad Lines West, Room 1106, Union Station, Pittsburg, Pa.

1905. ‡CRAWFORD, HARRY C. Inspector, Railway Equipments, 1015 Harrison Building, Philadelphia, Pa.

1909. *CREMER, FRITZ. Metallurgist and Chemist, Marshall-Wells Hardware Company, Duluth, Minn.

1907. CROCKARD, FRANK H. Vice-President and General Manager, Tennessee Coal, Iron and Railroad Company, Woodward Building, Birmingham, Ala.

1908. CROCKETT, ARTHUR E. Secretary and General Manager, Standard Chain Company, Pittsburg, Pa.

1906. CROMWELL, O. C. Mechanical Engineer, Baltimore and Ohio Railroad Company, Mount Clare, Baltimore, Md.

1909. *CROSBY, W. W. Chief Engineer, Maryland Geological and Economic Survey, Maryland Roads Commission, Johns Hopkins University, Baltimore, Md.

1908. CROWE AND COMPANY, F. T. 1105 A Street, Tacoma, Wash.

1904. *CROWELL, BENEDICT. Mining Engineer, 731 Williamson Building, Cleveland, O.

1903. CROXTON, H. A. President, Massillon Iron and Steel Company, Massillon, O.

1904. *CUMMINGS, ROBERT A. Consulting and Contracting Engineer, 316 Fourth Avenue, Pittsburg, Pa.

1906. *CUSHING, W. C. Chief Engineer, Maintenance of Way, Pennsylvania Lines, Southwest System, Union Station, Pittsburg, Pa.

1904. CUSHMAN, ALLERTON S. Chemist, Road Material Laboratory, United States Department of Agriculture, Washington, D. C.

1909. CUSTER, EDGAR A. President, Tacony Iron Company, Tacony, Philadelphia, Pa.

1908. ‡DALLAS, JOHN. Inspecting Engineer, 4910 North Twelfth Street, Philadelphia, Pa.

1906. DAMON, GEORGE A. Managing Engineer, The Arnold Company, Borland Building, Chicago, Ill.

1900. *DAVIDSON, GEORGE M. Engineer of Tests, Chicago and Northwestern Railroad, Chicago, Ill.

ELECTED.

1907. DAVIES, GEORGE C. Pilling and Crane, 1410 Real Estate Trust Building, Philadelphia, Pa.

1904. *DAVIS, CHANDLER. Civil Engineer, 11 Broadway, New York, N. Y.

1905. DAVIS, CHARLES HENRY. South Yarmouth, Mass.

1910. *‡DAVIS, EUGENE R. 117 Trowbridge Street, Cambridge, Mass.

1906. DAVIS, J. C. Assistant to First Vice-President, American Steel Foundries, Chicago, Ill.

1904. DAVIS, NATHAN H. President, Davis Solid Truss Brake Beam Company, Wilmington, Del.

1908. ‡DAVIS, ROLAND P. Instructor, Lincoln Hall, Cornell University, Ithaca, N. Y.

1904. DAVIS, WILLIAM M. Lubrication Engineer, 93 Broad Street, Boston, Mass.

1903. *DAVIS, WILLIAM R. Chief Bridge Designer, State Engineer's Office, Albany, N. Y.

1899. *DEANS, JOHN STERLING. Chief Engineer, Phœnix Bridge Company, Phœnixville, Pa.

1910. DE BERTODANO, JUAN L. Lieutenant-Commander Engineer, Argentine Navy, Homestead Steel Works, Munhall, Pa.

1906. *DECEW, J. A. Consulting Chemical Engineer, Sun Life Building, Montreal, Canada.

1908. DEEMES, J. F. General Superintendent, Motive Power, New York Central Lines, 610 Grand Central Station, New York, N. Y.

1905. *DEKNIGHT, EDWARD W. President and Manager, Hydrex Felt and Engineering Company, 120 Liberty Street, New York, N. Y.

1910. DE PIERREFEU, A. DEDONS. Assistant Metallurgical Engineer, Illinois Steel Company, South Chicago, Ill.

1910. DERBY, W. A. Acting Engineer of Tests, Chicago, Burlington and Quincy Railroad, Aurora, Ill.

1902. *DERLETH, CHARLES, JR. Professor of Structural Engineering, University of California, Berkeley, Cal.

1904. *DETROIT GRAPHITE COMPANY. F. W. Davis, Jr., Second Vice-President, 141 Broadway, New York, N. Y.

1903. DEVERELL, H. F. Secretary, Otis Steel Company, Cleveland, O.

1909. DEVOE (F. W.) AND C. T. RAYNOLDS COMPANY. Manufacturers of Paints and Varnishes, etc. Represented by Roland Molineaux, 101 Fulton Street, New York, N. Y.

ELECTED

1908. DEWAR, JOHN. Master Painter, 850 North Avenue, North Side, Pittsburg, Pa.

1904. DE WYRALL, CYRIL. Chief Inspector, Interborough Rapid Transit Company, New York City. *For Mail:* Ridgefield Park, N. J.

1907. DILKS, L. C. Eastern Steel Company, 71 Broadway, New York, N. Y.

1903. *DILLER, H. E. Metallurgist, Research Laboratory, General Electric Company, Schenectady, N. Y.

1902. DIXON CRUCIBLE COMPANY, JOSEPH. Malcolm MacNaughton, Superintendent, Paint and Lubricating Department, Jersey City, N. J.

1901. *DOBLE, WILLIAM A. President, Abner Doble Company, Seventh and South Streets, San Francisco, Cal.

1910. DODGE AND DAY. Engineers, 608 Chestnut Street, Philadelphia, Pa.

1907. DOKE, G. E. Chief Inspector of Materials, Lake Shore and Michigan Southern Railway Company, Collinwood, O.

1904. DOMINION BRIDGE COMPANY. Phelps Johnson, Manager, Montreal, Canada.

1905. *DONOHOE, JOHN P. Vice-President and General Manager, Donohoe Coke Company, Greensburg, Pa.

1907. DOUGHERTY, J. W. General Superintendent, Pennsylvania Steel Company, Steelton, Pa.

1909. DOUGHERTY, PROCTOR L. Inspector of Electric Light Plants, 1427 Girard Street, Washington, D. C.

1910. DOUGLASS, JAMES. President, The Phelps-Douglass Company, 99 John Street, New York, N. Y.

1909. DOUGLASS, W. J. With William Barclay Parsons, 60 Wall Street, New York, N. Y.

1906. DOUTY, D. E. Assistant Physicist, Bureau of Standards, Washington, D. C.

1898. *DOW, ALLAN W. 24 East Twenty-first Street, New York, N. Y.

1910. DOYLE, J. S. Superintendent Car Equipment, Interborough Rapid Transit Company, Ninety-eighth Street and Third Avenue, New York, N. Y.

1909. DRAKE, BRYANT S. Chemical Engineer, 5930 Colby Street, Oakland, Cal.

1910. *DRINKER, HENRY S. President, Lehigh University, South Bethlehem, Pa.

ELECTED.

1909. ‡DROWNE, HENRY B. Assistant Engineer, Rhode Island State Board of Public Roads, Box 3, East Side Station, Providence, R. I.

1904. DUBBS, J. A. President, Globe Asphalt Company, 405 Bakewell Building, Pittsburg, Pa.

1910. DUCKWORTH-BOYER ENGINEERING AND INSPECTION COMPANY, LIMITED, THE. 171 St. James Street, Montreal, Canada.

1902. DUCOMB, W. C., JR. Assistant Engineer, Standard Roller Bearing Company, Fiftieth Street and Lancaster Avenue, Philadelphia, Pa.

1902. DUDLEY, P. H. Consulting Engineer, Grand Central Station, New York, N. Y.

1909. DUDLEY, RAYMOND C. Representing Chicago-Cleveland Car Roofing Company, 720 Old Colony Building, Chicago, Ill.

1906. DUERR, H. O. General Manager, Diamond Stone Brick Company, Box 261, Wilmington, Del.

1901. DUFOUR, F. O. Assistant Professor of Structural Engineering, University of Illinois, Urbana, Ill.

1909. DUKES, RICHARD G. Professor of Applied Science, Purdue University, Lafayette, Ind.

1902. DUMARY, L. HENRY. President, The Helderberg Cement Company, 38 State Street, Albany, N. Y.

1902. DUNBAR, W. O. Assistant Engineer, Testing Department, Pennsylvania Railroad, Altoona, Pa.

1909. DUNN, B. W. Lieutenant-Colonel, Ordnance Department, United States Army, 24 Park Place, New York, N. Y.

1904. DUNN, W. R. Superintendent, Vulcanite Portland Cement Company, Phillipsburg, N. J.

1905. DUNNING, HUBERT. National Lead Company, 100 William Street, New York, N. Y.

1910. DUNSPAUGH, WILLIAM F. Vice-President, American Sewer Pipe Company, Beaver, Pa.

1904. DWIGHT, THEODORE. Mining Engineer, 15 Broad Street, New York, N. Y.

1907. *DYER, E. H. Secretary and Treasurer, Mound City Paint and Color Company, St. Louis, Mo.

1905. EAGLE WHITE LEAD COMPANY. F. J. Baringer, Chemist, Cincinnati, O.

1908. *ECKERSLEY, J. O. Assistant Engineer, Department of Bridges, New York City, Wakefield, New York, N. Y.

1910. *EDDY, HARRISON P. Consulting Engineer, 14 Beacon Street, Boston, Mass.

ELECTED.

1910. *EDWARDS, E. T. Superintendent, Melting Department, Firth-Sterling Steel Company, McKeesport, Pa.

1902. EDWARDS, WARRICK R. Assistant Engineer, Baltimore and Ohio Railroad, Baltimore and Ohio Building, Baltimore, Md.

1905. *EHRENFELD, CHARLES H. Chemist, York Manufacturing Company, York, Pa.

1904. *EIDLITZ, OTTO M. Civil Engineer, 489 Fifth Avenue, New York, N. Y.

1908. *EILERS, A. Member of Executive Committee of the American Smelting and Refining Company, 165 Broadway, New York, N. Y.

1908. EISENSCHIML, OTTO. Chemist, American Linseed Company, South Chicago, Ill.

1910. ELECTRICAL REVIEW AND WESTERN ELECTRICIAN. Morton G. Lloyd, Technical Editor, 507 Marquette Building, Chicago, Ill.

1909. *ELECTRICAL TESTING LABORATORIES. Clayton H. Sharp, Test Officer, Eightieth Street and East End Avenue, New York, N. Y.

1909. *ELLIOTT, ARTHUR H. Engineer and Chemist, Consolidated Gas Company, 4 Irving Place, New York, N. Y.

1908. *ELLIOTT, GEORGE K. Chief Chemist and Metallurgist, The Lunkenheimer Company, Cincinnati, O.

1905. ELLIS, THEODORE H. President, The Ellis Company, East Brooklyn Station, Baltimore, Md.

1910. *ELMQUIST, FREDERICK A. Railway Representative, The Sherwin-Williams Company, 50 Church Street, New York, N. Y.

1909. ELSON, HARRY E. Chemist, Masontown, Pa.

1910. ELWOOD, W. F. Chief Chemist, Keystone Coal and Coke Company, Greensburg, Pa.

1907. ELY, EDWARD F. Architect, 32 Westminster Street, Providence, R. I.

1896. *ELY, THEODORE N. Chief of Motive Power, Pennsylvania Railroad, Broad Street Station, Philadelphia, Pa.

1908. ELZNER AND ANDERSON. Architects. Ingalls Building, Cincinnati, O.

1909. *EMERSON LABORATORY, THE. Analytical and Industrial Chemists. F. W. Farrell, Chemist, 177 State Street, Springfield, Mass.

ELECTED.

1908. *EMERY, A. H. Civil Engineer, 288 Main Street, Stamford, Conn.

1898. ENGINEERING RECORD. 239 West Thirty-ninth Street, New York, N. Y.

1905. ENGINEERS' CLUB OF CINCINNATI. E. A. Cast, Secretary-Treasurer, Post Office Box 333, Cincinnati, O.

1905. ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA. Elmer K. Hiles, Secretary, 2511 Oliver Building, Pittsburg, Pa.

1905. ENRIGHT, BERNARD. Cement Expert and Analytical Chemist, 4036a Laclede Avenue, St. Louis, Mo.

1903. *ERLANDSEN, OSCAR. President, Metropolis Engineering Company, 329 Fulton Street, Jamaica, N. Y.

1903. ESTERLINE, J. WALTER. Assistant Professor of Electrical Engineering, Purdue University, Lafayette, Ind.

1910. *EUSTIS, W. E. C. Mining and Smelting, 131 State Street, Boston, Mass.

1909. EVANS, M. S. Chief Chemist, Bureau of Construction, City of Pittsburg, Center and Dithridge Streets, Pittsburg, Pa.

1906. EVANS, R. W. Treasurer, Picher Lead Company, 511 Tacoma Building, Chicago, Ill.

1904. EVANS, S. M. Manager, New York Office, Picher Lead Company, 100 William Street, New York, N. Y.

1905. EWING, W. W. Engineer, Westinghouse, Church, Kerr and Company, 10 Bridge Street, New York, N. Y.

1910. EYNON, D. L. Engineer, Duplex Metals Company, Chester, Pa.

1904. *FACKENTHAL, B. F., JR. President, Thomas Iron Company, Easton, Pa.

1908. FALK, H. S. Superintendent, The Falk Company, Milwaukee, Wis.

1905. FALK, MYRON S. Consulting Engineer, 30 Church Street, New York, N. Y.

1902. FALKENAU, A. Consulting Engineer, 995 Madison Avenue, New York, N. Y.

1909. FALKENBURG AND LAUCKS. Analytical Chemists, 95 Yesler Way, Seattle, Wash.

1909. *FARMER, F. M. Engineer, Electrical Testing Laboratories, Eightieth Street and East End Avenue, New York, N. Y.

1910. *FAY, A. G. President, Ætna Powder Company and Miami Powder Company, 143 Dearborn Street, Chicago, Ill,

ELECTED.

1902. FAY, HENRY. Professor of Analytical Chemistry, Massachusetts Institute of Technology, Boston, Mass.

1909. *FENNELL, JAMES T. Inspector, Parker Boiler Company, 1006 Pennsylvania Building, Philadelphia, Pa.

1903. FENNER, L. M. Chemical Engineer, H. H. Franklin Manufacturing Company, 342½ Delaware Street, Syracuse, N.Y.

1910. *FERGUSON, D. M. Assistant Chief Engineer, The E-M-F Company, 253 Rosedale Court, Detroit, Mich.

1907. FERGUSON, F. W. Architect, 15 Beacon Street, Boston, Mass.

1909. FERGUSON, LEWIS R. Civil Engineer, 1330 Land Title Building, Philadelphia, Pa.

1909. FERNALD, ROBERT HEYWOOD. Professor of Mechanical Engineering, Case School of Applied Science, Cleveland, O.

1905. FERNOW, B. E. Dean, Forestry Department, University of Toronto, Toronto, Canada.

1908. FETTY, I. H. Keith and Perry Building, Kansas City, Mo.

1906. *FINDLEY, A. I. Editor, *The Iron Age*, 14 Park Place, New York, N. Y.

1909. FIREMAN, PETER. Manufacturing Chemist, Cosmos Club, Washington, D. C.

1910. *FIRMSTONE, F. Blast Furnace Manager, Easton, Pa.

1910. *FISHER, HENRY W. Chief Engineer, Standard Underground Cable Company, Westinghouse Building, Pittsburg, Pa.

1908. FISHER, THOMAS. General Superintendent, 305 Betz Building, Philadelphia, Pa.

1909. *FITCH, HARRY M. Care of W. P. Fuller and Company, 301 Mission Street, San Francisco, Cal.

1908. *FITTERER, J. C. Professor of Civil and Irrigation Engineering, University of Wyoming, Laramie, Wy.

1903. *FITZ GERALD, FRANCIS A. J. Chemical Engineer, Fitz Gerald and Bennie Laboratories, Niagara Falls, N. Y.

1899. FLAGG, STANLEY G., JR. Stanley G. Flagg and Company, Nineteenth Street and Pennsylvania Avenue, Philadelphia, Pa.

1904. *FLEMING, HENRY S. Consulting Engineer, Room 116, 1 Broadway, New York, N. Y.

1908. *‡FLYNN, J. H., JR. Mechanical Engineer, Gorgona, Canal Zone.

ELECTED.

1906. FOLLER, CHARLES S. Mechanical Engineer, Union Spring Manufacturing Company, Farmers' Bank Building, Pittsburg, Pa.

1907. *FORCE, H. J. Chemist and Engineer of Tests, Delaware, Lackawanna and Western Railroad Company, Scranton, Pa.

1904. FORD, ALLEN P. Metallurgist, Eaton, Cole and Burnham Company, Bridgeport, Conn.

1901. FORREST, C. N. Chief Chemist, New York Testing Laboratory, Maurer, N. J.

1909. *FORSTALL, ALFRED E. Consulting Engineer, 58 William Street, New York, N. Y.

1910. *FORSYTH, ROBERT. Consulting Engineer, 1159 The Rookery, Chicago, Ill.

1903. FORSYTH, WILLIAM. Mechanical Engineer, *Railroad Age Gazette*, Chicago, Ill.

1910. *FORT, EDWIN J. Chief Engineer of Sewers, Borough of Brooklyn, 215 Montague Street, Brooklyn, N. Y.

1905. FOX, ADAM H. President, American Equipment Company, Norristown, Pa.

1908. FRANCIS, J. RICHARD. Chemist, Cleveland, Cincinnati, Chicago and St. Louis Railway, Indianapolis, Ind.

1906. FRANK, JEROME W. Chemist, Standard Varnish Works, 29 Broadway, New York, N. Y.

1898. FRANKLIN INSTITUTE. R. B. Owens, Secretary, 15 South Seventh Street, Philadelphia, Pa.

1907. *FRANKLIN MANUFACTURING COMPANY, H. H. 400 South Geddes Street, Syracuse, N. Y.

1905. *FREEMAN, JOHN R. Consulting Engineer, 814 Banigan Building, Providence, R. I.

1903. *FRENCH, JAMES B. Bridge Engineer, Room 1276, 50 Church Street, New York, N. Y.

1904. FROEHLING AND ROBERTSON. Analytical Chemists, Chemical and Mining Engineers, 17 South Twelfth Street, Richmond, Va.

1909. FROHMAN, E. D. Secretary, The S. Obermayer Company, Pittsburg, Pa.

1905. *FRY, LAWFORD H. Technical Representative in Europe of the Baldwin Locomotive Works, 64 Rue de la Victoire, Paris, France.

1907. FRYE, ALBERT I. Consulting Engineer, 90 West Street New York, N. Y.

ELECTED.

1908. FUEL ENGINEERING COMPANY. H. Cheney, President, 1712 Marquette Building, Chicago, Ill.

1903. *FULLER, ALMON H. Professor of Civil Engineering, Washington University, University Station, Seattle, Wash.

1906. FULLER, CHARLES E. Associate Professor of Mechanical Engineering, Massachusetts Institute of Technology, Boston, Mass.

1908. FULLER, J. W., JR. General Manager, Lehigh Car Wheel and Axle Works, Catasauqua, Pa.

1904. FULLER, WILLIAM B. Expert Engineer, Room 1135, 150 Nassau Street, New York, N. Y.

1909. *FULWEILER, W. HERBERT. Department of Tests, United Gas Improvement Company, Room 514, United Gas Improvement Building, Broad and Arch Streets, Philadelphia, Pa.

1910. FURST, E. W. With The Grassilli Chemical Company, 784 Arcade, Cleveland, O.

1908. GADD, CHARLES J. Engineer, American Iron and Steel Manufacturing Company, Lebanon, Pa.

1905. *GAEHR, DAVID. Contracting Engineer, 1135 Schofield Building, Cleveland, O.

1910. ‡GAGE, CLARENCE E. Chief Draftsman, Cincinnati Equipment Company, 3716 Liston Avenue, Cincinnati, O.

1909. *GAINES, RICHARD H. Chemist, Board of Water Supply, New York City, 147 Varick Street, New York, N. Y.

1903. GALBRAITH, J. Principal, School of Practical Science, University of Toronto, Toronto, Canada.

1908. ‡GARDNER, HENRY A. Director, Scientific Section, Paint Manufacturers' Association of United States, 3500 Gray's Ferry Road, Philadelphia, Pa.

1905. GARFIELD, ALEXANDER STANLEY. Chief Engineer, Cie. Francaise Thomson-Houston; Consulting Engineer, Mediterranean Thomson-Houston Company and General Electric Company. 67 Avenue De Malakoff, Paris, France.

1905. GARLINGHOUSE, F. L. Structural Engineer, Jones and Laughlin Steel Company, Glenshaw, Pa.

1909. *GARRISON, O. L. President, Big Muddy Coal and Iron Company, 912 Wainwright Building, St. Louis, Mo.

1909. GATES, W. D. President and General Manager, American Terra Cotta and Ceramic Company, 602 Chamber of Commerce Building, Chicago, Ill.

ELECTED.

1905. GAY, MARTIN. Assistant Engineer, Department of Bridges, New York City, 103 East One Hundred and Twenty-fifth Street, New York, N. Y.

1910. GAYLEY, JAMES. Manufacturer, 71 Broadway, New York, N. Y.

1907. GEER, WILLIAM C. Chief Chemist, B. F. Goodrich Company, 218 Park Street, Akron, O.

1908. GENERAL ELECTRIC COMPANY. J. A. Capp, Chief of Testing Laboratory, Schenectady, N. Y.

1909. GENERAL ELECTRIC COMPANY, LYNN WORKS. J. M. Darke, Chief of Testing Laboratories, West Lynn, Mass.

1909. GEORGE, W. H. Secretary, Cowell Portland Cement Company 95 Market Street, San Francisco, Cal.

1910. GERETY, R. M. Architectural Engineer, Department of Buildings, Chicago, Ill.

1905. *GERLACH, O. Manager, Mobile Portland Cement and Coal Company, Van Antwerp Building, Mobile, Ala.

1902. *GERSTELL, A. F. Vice-President and General Manager, Alpha Portland Cement Company, Alpha, N. J.

1906. *GIBBONEY, JAMES H. Chief Chemist, Norfolk and Western Railway Company, 414 Thirteenth Avenue, S. W., Roanoke, Va.

1902. GIBBS, A. W. General Superintendent of Motive Power, Pennsylvania Railroad, Altoona, Pa.

1902. *GIBBS, GEORGE. Chief Engineer of Electric Traction, Pennsylvania Tunnel and Terminal Railroad Company, 10 Bridge Street, New York, N. Y.

1908. GIBSON, HARRY C. With Larkin Company, Buffalo, N. Y.

1905. GIESLER, ARTHUR. Consulting Engineer, Dayton, O.

1910. ‡GIFFORD, A. McK. Chemist, General Electric Company, Pittsfield Works, 20 Linden Street, Pittsfield, Mass.

1907. GILG, HENRY F. 1223 Island Avenue, N. S., Pittsburg, Pa.

1905. *GILL, AUGUSTUS H. Assistant Professor of Technical Analysis, Massachusetts Institute of Technology, Boston, Mass.

1906. GINDER, WILLIAM H. H. Chemist and Engineer of Tests, Eastern Steel Company, Pottsville, Pa.

1904. *GIROUX, GUSTAVE. Inspector of Materials, Canadian Pacific Railway Company, 1101 East Craig Street, Montreal, Canada.

ELECTED.

1904. *GLASGOW IRON COMPANY. C. B. Shoemaker, President, 603-608 Harrison Building, Philadelphia, Pa.

1909. *GLIDDEN, FRED. A. Vice-President, Glidden Varnish Company, Cleveland, O.

1909. *GLOVER, GEORGE J. General Contractor, 1111 Hibernia Building, New Orleans, La.

1910. GOETZE, FREDERICK A. Dean of the Schools of Mines, Engineering and Chemistry, Columbia University, New York, N. Y.

1910. ‡GOLDBECK, ALBERT T. Instructor in Civil Engineering, Lafayette College, Easton, Pa.

1910. *GOLDMARK, HENRY. Designing Engineer, Isthmian Canal Commission, Culebra, Canal Zone.

1909. *GOODENOUGH, WALTER. Engineer, Stone and Webster Engineering Corporation, Boston, Mass.

1904. GOODMAN, CARLTON M. Superintendent, Security Cement and Lime Company, Security, Md.

1908. *GOODRICH, E. P. Consulting Engineer, 1 Wall Street, New York, N. Y.

1904. GOODSPEED, G. M. Metallurgist, National Tube Company, McKeesport, Pa.

1910. *GORMULLY, A. R. Contracting Agent, 570 South Broadway, Yonkers, N. Y.

1907. GOSA, HERBERT O. University of Alabama, Tuscaloosa, Ala.

1910. GOSS, EDWARD O. Assistant Manager, Scovill Manufacturing Company, Waterbury, Conn.

1907. GOSS, OLIVER P. M. Engineer of Timber Tests, United States Forest Service. *For Mail:* Post Office Box 112, University Station, Seattle, Wash.

1896. *GOSS, WILLIAM F. M. Dean of the Schools of Engineering, University of Illinois, Urbana, Ill.

1908. GOULD, W. S. President, Fuel Engineering Company of New York, 59 Pearl Street, New York, N. Y.

1908. *GOWIE, WILLIAM. Box 175, Kittanning, Pa.

1906. *GRACE, S. P. Chief Engineer, Central District and Printing Telegraph Company, Pittsburg, Pa.

1909. GRAY, H. W. Assistant Professor of Experimental Civil Engineering, in charge of Structural and Hydraulic Laboratories, Iowa State College, Ames, Ia.

1903. *GRAY, JOHN LATHROP. Assistant Superintendent, Tidewater Oil Company, East Twenty-second Street, Bayonne, N. J.

ELECTED.

1905. *‡GRAY, THOMAS TARVIN. Chemist, Tide-water Oil Company, East Twenty-second Street, Bayonne, N. J.

1910. GREELEY, SAMUEL A. Resident Engineer, Milwaukee Refuse Incineration Plant, City Hall, Milwaukee, Wis.

1906. *GREEN, HERBERT. Mechanical Engineer, Peoples Gas Building, Chicago, Ill.

1910. ‡GREENE, E. T. Chemist, Henry S. Spackman Engineering Company, 42 North Sixteenth Street, Philadelphia, Pa.

1905. GREENE, GEORGE W. Inspecting Engineer, American Bureau of Inspection and Tests, 313 Wabash Building, Pittsburg, Pa.

1904. *GREENMAN, RUSSELL S. Resident Engineer in charge of Tests, Department of State Engineering and Surveying, Albany, N. Y.

1907. *GREGG, NORRIS B. President, Mound City Paint and Color Company, St. Louis, Mo.

1906. GREGORY, E. D. Mill Manager, Frazer Paint Company, Bedford City, Va.

1906. GREGORY, JOHN H. Hydraulic and Sanitary Engineer, 53 Christopher Street, Montclair, N. J.

1909. *‡GREIFENHAGEN, EDWIN O. Architectural Engineer, Department of Buildings, City of Chicago. *For Mail:* 823 Wellington Avenue, Chicago, Ill.

1902. GREINER, J. E. Consulting Engineer, 605 Continental Building, Baltimore, Md.

1907. GRIESENAUER, GEORGE J. Inspector of Cement, Chicago, Milwaukee and St. Paul Railway Company, 194 Fullerton Avenue, Chicago, Ill.

1906. GRIFFITH, R. E. Vice-President, American Cement Company, 604 Pennsylvania Building, Philadelphia, Pa.

1906. *GRIFFITHS, T. S. General Manager, Canadian Inspection Company, 204 St. James Street, Montreal, Canada.

1910. GROSE, JAMES H. Superintendent, Howard Axle Works, Carnegie Steel Company, Homestead, Pa.

1909. *GUDEMAN, EDWARD. Chemical Engineer, 903 Postal Telegraph Building, Chicago, Ill.

1907. GULICK, HENRY, JR. Gulick-Henderson Company, 439 Third Avenue, Pittsburg, Pa.

1908. HAAS, FRANK R. Consulting Engineer, The Consolidation Coal Company, Fairmont, W. Va.

ELECTED.

1906. *HADFIELD, R. A. Steel Manufacturer, Hecla Works, Sheffield, England.

1901. HAGAR, EDWARD M. President, Universal Portland Cement Company, Commercial Bank Building, Chicago, Ill.

1910. HAGER, ALBERT B. Secretary, Fidelity Engineering and Inspecting Company, 30 Church Street, New York, N. Y.

1906. HAINES, JOHN L. Assistant to Vice-President, Jones and Laughlin Steel Company, Pittsburg, Pa.

1905. HALDEMAN, HORACE L. Treasurer, Pulaski Iron Company, 1008 Real Estate Trust Building, Philadelphia, Pa.

1910. *HALE, RICHARD KING. Civil Engineer, 85 Water Street, Boston, Mass.

1910. HALL, CLARENCE. Explosives Engineer, Fortieth and Butler Streets, Pittsburg, Pa.

1910. *HALL, JOHN H. Metallurgist, Taylor Iron and Steel Company, High Bridge, N. J.

1903. *HALLETT, NELSON A. Cement Inspector, 1 Ashburton Place, Boston, Mass.

1908. HAMBURGER, SAMUEL. Assistant Engineer, Department of Bridges, City of New York, 133 West One Hundred and Thirtieth Street, New York, N. Y.

1910. *HAMMOND, GEORGE T. Engineer of Design, Bureau of Sewers, Brooklyn, 156 Berkeley Place, Brooklyn, N. Y.

1903. *HANCOCK, E. L. Professor of Applied Mechanics, Worcester Polytechnic Institute, Worcester, Mass.

1905. *HAND, ELWOOD STOKES. Special Representative, Pennsylvania Wire Glass Company, 100 Broadway, New York, N. Y.

1905. ‡HANNA, W. C. Chemist, California Portland Cement Company, Colton, Cal.

1905. HARDING, CHESTER. Captain, Corps of Engineers, United States Army, Gatun, Canal Zone.

1909. HARDING, C. L. Architect, 729 Fifteenth Street, Washington, D. C.

1904. HARDING, JAMES J. Engineer of Masonry Construction, Chicago, Milwaukee and St. Paul Railway, Miles City, Mont.

1902. HARDING, W. H. President, Coplay Cement Manufacturing Company, 517 Pennsylvania Building, Philadelphia, Pa.

1903. *HARGROVE, JULIAN O. Inspector of Asphalt and Cements, 1603 O Street, N. W., Washington, D. C.

ELECTED.

1902. *HARRIMAN, N. F. Chemist and Engineer of Tests, Union Pacific Railroad, Omaha, Neb.

1907. HARRIS, ALBERT W. Purchasing Agent, Laurentide Paper Company, Limited, Grand Mere, Quebec, Canada.

1908. HARRIS, J. R. Chief Chemist, T. C. I. & R. R. Co., Box 731, Birmingham, Ala.

1908. HARTFORD MACHINE SCREW COMPANY. P. B. Gale, Vice-President and General Manager, Hartford, Conn.

1902. *HARTFORD STEAM BOILER INSPECTION AND INSURANCE COMPANY. Francis B. Allen, Vice-President, Hartford, Conn.

1904. HARTLEY, HENRY J. Superintendent, Boiler Department, William Cramp and Sons, 1624 Oxford Street, Philadelphia, Pa.

1898. HARTRANFT CEMENT COMPANY, WILLIAM G. Sole Selling Agent for Old Dominion and Phœnix Portland Cement, Real Estate Trust Building, Philadelphia, Pa.

1905. *HARVARD COLLEGE LIBRARY. Alfred C. Potter, Assistant Librarian, Cambridge, Mass.

1898. *HATT, WILLIAM K. Professor of Applied Mechanics, Purdue University, Lafayette, Ind.

1910. HAVENS, WILLIAM W. Assistant Engineer, Public Service Commission for the First District, State of New York, 469 East One Hundred and Thirty-fourth Street, New York, N. Y.

1904. *HAWXHURST, ROBERT, JR. Consulting Engineer, 623 Salisbury House, London, E. C., England.

1906. HAYES, J. ARTHUR. Resident Manager, United States Cast Iron Pipe and Foundry Company, Burlington, N. J.

1907. HAYWARD, HENRY E. Engineer of Tests, Link-Belt Company, Nicetown, Philadelphia, Pa.

1906. *HAYWARD, H. W. Instructor, Mechanical Engineering, Massachusetts Institute of Technology, Boston, Mass.

1906. HAZARD MANUFACTURING COMPANY. John C. Bridgman, General Manager, Wilkesbarre, Pa.

1907. HAZEN, WILLIAM NELSON. Engineer, Expanded Metal Engineering Company, Union Building, Newark, N. J.

1906. HEALD, E. C. Chief Structural Engineer, Office of Supervising Architect, Treasury Department, Washington, D. C.

1903. HEARNE, W. W. Member of firm Mathew Addy and Company, 1625 Real Estate Trust Building, Philadelphia, Pa.

ELECTED.

1910. *HEATH, GEORGE L. Chemist, Calumet and Hecla Smelting Works, Hubbell, Mich.

1905. HECKEL, G. B. Editor, *Drugs, Oils and Paints*, 634–36 The Bourse, Philadelphia, Pa.

1910. HEIBERG, C. F. Consulting Chemist, 630 Worcester Building, Portland, Ore.

1904. HEIDENREICH, E. LEE. Special Engineer, New York Central and Hudson River Railroad, 1220 Grand Central Station, New York, N. Y.

1910. HEINRICH, E. O. City Chemist, 3214 North Thirtieth Street, Tacoma, Wash.

1910. ‡HEIZMANN, L. J. Mechanical Engineer, Penn Hardware Company, 318 North Fifth Street, Reading, Pa.

1909. HELLER AND WILSON. Consulting Engineers, First National Bank Building, San Francisco, Cal.

1909. HELLING, G. W. Care of Chicago, Milwaukee and St. Paul Railway Company, 1242 Railway Exchange, Chicago, Ill.

1904. *HELWIG, ALFRED. Engineer, Edison Electric Illuminating Company, 360 Pearl Street, Brooklyn, N. Y.

1904. *HEMSTREET, GEORGE P. Superintendent, Hastings Pavement Company, Hastings-upon-Hudson, N. Y.

1910. HENDRICKS, A. B., JR. Engineer of Materials, General Electric Company, Pittsfield Works, 212 East Street, Pittsfield, Mass.

1903. HENSHAW, JOHN O. Member, N. S. Bartlett and Company, 126 State Street, Boston, Mass.

1909. HEPPINSTALL, C. W. Secretary and Treasurer, Heppinstall Forge and Knife Company, Forty-seventh Street and Allegheny Valley Railway, Pittsburg, Pa.

1904. *HERING, RUDOLPH. Hydraulic and Sanitary Engineer, 170 Broadway, New York, N. Y.

1910. HERRESHOFF, JAMES B., JR. Superintendent, Nichols Copper Company, Laurel Hill, N. Y.

1906. *HERSEY, MILTON L. City and Provincial Analyst, 171 St. James Street, Montreal, Canada.

1910. ‡HEWITT, THOMAS E. Assistant Chemist, American Sheet and Tin Plate Company, 331 Atwood Street, Pittsburg, Pa.

1910. *HIBBARD, HENRY D. Consulting Engineer, 144 East Seventh Street, Plainfield, N. J.

1902. HILDRETH, P. S. Consulting and Inspecting Engineer, 135 Broadway, New York, N. Y.

ELECTED.

1910. HILL, C. D. Engineer, Board of Local Improvements; City Hall, Chicago, Ill.

1909. HILL, NICHOLAS S., JR. Consulting Engineer, 100 William Street, New York, N. Y.

1909. HILLEBRAND, W. F. Chief Chemist, Bureau of Standards, Washington, D. C.

1909. *HILLES, RAYMOND W. Sales Manager, Paint and Varnish Department, S. H. French and Company, York Avenue, Fourth and Callowhill Streets, Philadelphia, Pa.

1907. HINCKLEY, BENJAMIN S. Engineer of Tests, New York, New Haven and Hartford Railroad Company, New Haven, Conn.

1907. HINCKLEY, J. F. Civil and Consulting Engineer, 1423 Syndicate Trust Building, St. Louis, Mo.

1906. HOBBS, F. E. Lieutenant-Colonel, commanding Rock Island Arsenal, Rock Island, Ill.

1910. HODGES, HARRISON B. Purchasing Agent and Superintendent of Tests, Long Island Railway Company, New York, N. Y.

1904. *HOFF, OLAF. Consulting Engineer, 149 Broadway, New York, N. Y.

1907. HOFFHINE, JOHN. First Assistant Chemist, Union Pacific Railroad, Lock Box 273, Omaha, Neb.

1902. HOFMAN, H. O. Professor of Metallurgy, Massachusetts Institute of Technology, Boston, Mass.

1907. HOGUE, CHESTER J. Constructing Engineer, Eastern Expanded Metal Company, 101 Tremont Street, Boston, Mass.

1907. *HOKANSON, MARTIN. Assistant Professor of Materials of Construction, Carnegie Technical Schools, Pittsburg, Pa.

1908. HOLLEY, CLIFFORD D. General Superintendent, The Lead Products Company, St. Louis, Mo. *For Mail:* 3215 Papin Street, St. Louis, Mo.

1906. ‡HOLMES, ADDISON F. Instructor, Mechanical Engineering, Massachusetts Institute of Technology, Boston, Mass.

1903. HOLMES, JOSEPH A. Expert in charge, Technologic Branch, United States Geological Survey, Washington, D. C.

1907. *HOLST, J. L. Engineer of Structures, New York Central and Hudson River Railroad, 335 Madison Avenue, New York, N. Y.

ELECTED.

1906. *HOOKER, A. H. Care of Development and Funding Company, Niagara Falls, N. Y.

1904. HOPTON, W. E. Assistant Purchasing Engineer, Solvay Process Company, Syracuse, N. Y.

1910. HORN, A. C. Waterproofing Contractor, 8–10 Burling Slip, New York, N. Y.

1908. HORNLEIN AND NOBLE. Cement Experts, 217 Humboldt Bank Building, San Francisco, Cal.

1908. *HOVEY, O. E. Assistant Chief Engineer, American Bridge Company of New York, Hudson Terminal, 30 Church Street, New York, N. Y.

1904. HOW, R. W. Assistant Engineer, Long Island Railroad Company, R. D. No. 3, Perry, N. Y.

1908. ‡HOWARD, CHARLES W. Instructor in Materials of Construction, Carnegie Technical School, Pittsburg, Pa.

1906. HOWARD, JAMES E. Engineer-Physicist, Bureau of Standards, Washington, D. C.

1909. HOWARD, JAMES W. Consulting Engineer, 1 Broadway, New York, N. Y.

1903. HOWARD, L. E. Superintendent, Simonds Manufacturing Company, Seventeenth Street and Western Avenue, Chicago, Ill.

1909. *HOWARD, O. ZELL. Mechanical Engineer, United States Naval Experiment Station, Annapolis, Md.

1896. *HOWE, HENRY M. (*President*). Professor of Metallurgy, Columbia University, Broad Brook Road, Bedford Hills, N. Y.

1909. HOWE, MALVERD A. Professor of Civil Engineering, Rose Polytechnic Institute, 2108 North Tenth Street, Terre Haute, Ind.

1910. HOWELL, SPENCER B. Assistant Engineer, United States Geological Survey, Fortieth and Butler Streets, Pittsburg Pa.

1909. HOXIE, FREDERICK J. Engineer and Special Inspector, Mutual Fire Insurance Company's Factory, Phenix, R. I.

1908. ‡HUBBARD, PRÉVOST. Assistant Chemist, Office of Public Roads, United States Department of Agriculture, Washington, D. C.

1904. *HUBBELL, C. A. President, R. Almond Manufacturing Company, Ashburnham, Mass.

1904. HUBER, FREDERICK W. Consulting Chemical Engineer, Grosse Building, Los Angeles, Cal.

ELECTED.

1905. *HUDSON, H. N. General Manager, Hoyt Metal Company, St. Louis, Mo.

1905. HUGHES AND PATTERSON. Manufacturers of Bar Iron, 800 Richmond Street, Philadelphia, Pa.

1905. *HUGHES, HECTOR J. Assistant Professor of Hydraulics and Sanitary Engineering, Harvard University, 114 Pierce Hall, Cambridge, Mass.

1907. HUGHES, L. S. Chief Chemist, Picher Lead Company, Joplin, Mo.

1904. HUME, A. P. Engineer of Tests, American Bridge Company, Pencoyd, Pa.

1896. *HUMPHREY, RICHARD L. Consulting Engineer and Chemist, 805 Harrison Building, Philadelphia, Pa.

1903. HUNNINGS, S. V. Chemist and Engineer of Tests, American Locomotive Company, Schenectady, N. Y.

1903. *HUNT, LOREN E. Bureau of Engineering, Department of Public Works, San Francisco, Cal. *For Mail:* 38 Sixth Avenue, San Francisco, Cal.

1899. *HUNT COMPANY, ROBERT W. Inspecting and Testing Engineers, 1121 The Rookery, Chicago, Ill.

1903. HUNTER, JOSEPH W. Engineer and Surveyor, State Highway Commissioner, Harrisburg, Pa.

1910. HUTCHINS, H. C. Secretary, Ajax Forge Company, Hoyne Street and Blue Island Avenue, Chicago, Ill.

1906. HUTCHINSON, CARY T. Consulting Engineer, 60 Wall Street, New York, N. Y.

1905. HYDE, A. LINCOLN. Assistant Professor of Bridge Engineering, University of Missouri, Columbia, Mo.

1903. HYDE, CHARLES G. Assistant Professor of Sanitary Engineering, University of California, Berkeley, Cal.

1906. ICKES, ELWOOD T. Inspector, Carnegie Steel Company, Room 522, Carnegie Building, Pittsburg, Pa.

1904. *ILLINOIS CENTRAL RAILROAD COMPANY. J. T. Harahan, Engineer, Commercial National Bank Building, Chicago, Ill.

1900. ILLINOIS STEEL COMPANY. P. E. Carhart, Inspecting Engineer, Rookery Building, Chicago, Ill.

1906. INGALLS, F. P. Chemist, John W. Masury and Son, 1329 Fiftieth Street, Brooklyn, N. Y.

1903. INSURANCE ENGINEERING. Franklin Webster, Editor, 120 Liberty Street, New York, N. Y.

ELECTED.

1902. INTERNATIONAL ACHESON GRAPHITE COMPANY. Manufacturers of Graphite and Graphite Articles. W. Acheson Smith, Vice-President, Niagara Falls, N. Y.

1904. INTERNATIONAL HARVESTER COMPANY. John G. Wood, Second Assistant Manager, Manufacturing Department, 7 Monroe Street, Chicago, Ill.

1908. *INTERNATIONAL PAPER COMPANY. Charles F. Rhodes, Superintendent, Bureau of Tests, Glens Falls, N. Y.

1902. IRON TRADE REVIEW, THE. A. O. Backert, Associate Editor, Cleveland, O.

1896. JARECKI, ALEXANDER. Superintendent, Jarecki Manufacturing Company, Limited, Erie, Pa.

1905. JEFFERS, JOHN M. Oil Inspector, National Tube Company, 1603 Jenny Lind Street, McKeesport, Pa.

1909. ‡JENKINS, WESTON, JR. General Manager, Susquehanna Iron Company, Columbia, Pa.

1908. JENKS, ROBERT J. Manager, Berwind-White Coal Mining Company, 1 Broadway, New York, N. Y.

1904. JENNINGS, ARTHUR S. Editor, *The Decorator*, 365 Birkbeck Bank Chambers, High Holborn, London, W. C., England.

1910. *JENNINGS, ROBERT E. President, The Carpenter Steel Company, 100 Broadway, New York, N. Y.

1909. ‡JENNISON, H. C. Testing of Materials, Box 313, Ansonia, Conn.

1900. *JEWETT, J. Y. Cement Expert, United States Reclamation Service, 408 Commonwealth Building, Denver, Colo.

1900. JOB, ROBERT. Vice-President, Milton Hersey Company, Limited, 171 St. James Street, Montreal, Canada.

1903. *JOHNSON, ALBERT L. Chief Engineer, Expanded Metal Fireproofing Company, 606 Century Building, St. Louis, Mo.

1903. JOHNSON, ARTHUR N. State Highway Engineer, Springfield, Ill.

1910. JOHNSON, CHARLES W. Assistant Manager of Works, Westinghouse Electric and Manufacturing Company, 6823 Thomas Boulevard, Pittsburg, Pa.

1904. JOHNSON, J. S. A. Professor of Experimental Engineering, Virginia Polytechnic Institute, Blacksburg, Va.

ELECTED.

1904. JOHNSON, LEWIS J. Professor of Civil Engineering, Harvard University, 309 Pierce Hall, Cambridge, Mass.

1910. ‡JOHNSON, REEVES K. Engineer of Tests, Baldwin Locomotive Works, Philadelphia, Pa.

1906. JOHNSTON, WILLIAM A. Associate Professor of Mechanical Engineering, Massachusetts Institute of Technology, Boston, Mass.

1902. *JONES AND LAUGHLIN STEEL COMPANY. Steel Manufacturers. Willis L. King, Vice-President, Pittsburg, Pa.

1905. *JONES, C. R. Professor of Mechanical Engineering, West Virginia University, Morgantown, W. Va.

1909. JONES, JESSE. In charge of Physical and Chemical Laboratory, Research Division, Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. *For Mail:* 612 E Street, Oakmont, Pa.

1908. JONES, JOHN H. President, The Pittsburg-Buffalo Company, 414 Frick Building, Pittsburg, Pa.

1909. JONES, J. RAYMOND. Engineering Department, Alan Wood Iron and Steel Company, Conshohocken. Pa.

1908. JONES, SULLIVAN W. Architect, 63 William Street, New York, N. Y.

1908. JONSON, ERNST. Engineer Inspector, Board of Water Supply, 147 Varick Street, New York, N. Y.

1910. ‡JORDAN, HARRY E. In charge of Filtration Department, Indianapolis Water Company, 113 Monument Place, Indianapolis, Ind.

1903. JORDAN, WILLIAM, JR. Bala, Pa.

1908. JOSIAS, HERMAN. Purchasing Agent, The Cuba Railroad, 170 Broadway, New York, N. Y.

1906. *KAUFMAN, GUSTAVE. Chief Engineer, The Wilson and Baillie Manufacturing Company, 26 Court Street, Brooklyn, N. Y.

1907. *KAVANAUGH, WILLIAM H. Professor of Experimental Engineering, University of Minnesota, Minneapolis, Minn.

1904. *KAY, EDGAR B. Professor of Engineering, University of Alabama, University, Ala.

1907. KAYLOR, JOHN J. Mechanical Inspector, 3456 Gass Avenue, Allegheny, Pa.

1906. KEARNS, W. F. 161 Devonshire Street, Boston, Mass.

ELECTED.

1903. KEAY, H. O. Assistant Professor of Mechanical Engineering, McGill University, Montreal, Canada.

1908. KELLER, W. H. Chief Electrician, The New River Collieries Company, Ansted, W. Va.

1910. KELLEY, FREDERICK W. Vice-President, Helderburg Cement Company, 78 State Street, Albany, N. Y.

1908. KEMMERER, JOHN L. Coal Operator, 143 Liberty Street, New York, N. Y.

1899. KENNEDY, FRANK G., JR. 408 North American Building, Philadelphia, Pa.

1904. *KENNEDY, JEREMIAH J. Consulting Engineer, 52 Broadway, New York, N. Y.

1904. *KENNEY, E. F. Metallurgical Engineer, Cambria Steel Company, Johnstown, Pa.

1906. KENNEY, LEWIS HOBART. Draftsman in charge, Manufacturing Department, Machinery Division, United States Navy Yard, Philadelphia, Pa.

1902. KENT, WILLIAM. Professor of Mechanical Engineering, 49 Union Street, Montclair, N. J.

1908. KENT, W. C. Second Vice-President, Whitehall Portland Cement Company, 1722 Land Title Building, Philadelphia, Pa.

1910. ‡KERNS, JOHN J. Assistant, Metallurgical Laboratory, High Bridge, N. J.

1910. *‡KERR, C. H. Research Chemist, American Optical Company, Southbridge, Mass.

1905. KETCHUM, MILO S. Dean of the College of Civil Engineering, University of Colorado, 438 Century Building, Denver, Colo.

1908. *KEWISH, W. H. Chief Chemist, Dixie Portland Cement Company, South Pittsburg, Tenn.

1907. KIEFER, H. E. Chemist, Edison Portland Cement Company, Stewartsville, N. J.

1903. KIESEL, W. F., JR. Assistant Mechanical Engineer, Pennsylvania Railroad, Altoona, Pa.

1906. *KIMMEL, H. R. Chemist, Industrial Testing Laboratory Superior Building, Cleveland, O.

1910. KING, D. M. Major, Ordnance Department, United States Army, Rock Island Arsenal, Rock Island, Ill.

1899. *KINKEAD, J. A. Manager of Sales, The Parkesburg Iron Company, 2601 Singer Building, New York, N. Y.

ELECTED.

1908. *‡KINNEY, WILLIAM M. Assistant Inspecting Engineer, Universal Portland Cement Company, 522 Frick Building, Pittsburg, Pa.

1902. *KIRCHHOFF, C. 422 West End Avenue, New York, N. Y

1903. *KIRCHNER, PAUL A. Structural Engineer, 40 West Thirty-sixth Street, New York, N. Y.

1909. ‡KIRSCHBRAUN, LESTER. Asphalt Chemist, City of Chicago, 204 East Michigan Street, Chicago, Ill.

1903. *KITTREDGE, H. G. Secretary, The Kay and Ess Company, Dayton, O.

1910. KNIGHT, S. S. With Scullin-Gallagher Steel and Iron Company, 6700 Manchester Avenue, St. Louis, Mo.

1903. *KNIGHTON, J. A. Engineer in charge of Construction, Blackwell's Island Bridge, 56 Sutton Place, New York, N. Y.

1906. *KNISELY, EDWARD S. Western Representative, Bethlehem Steel Company, Box 1017, Pittsburg, Pa.

1904. KNOWLES, MORRIS. Chief Engineer, Bureau of Filtration, Pittsburg, Pa.

1909. KOCH, GEORGE B. Foreman, Physical Laboratory, Pennsylvania Railroad Company, 809 Chestnut Avenue, Altoona, Pa.

1903. KOHR, D. A. Chemist, The Lowe Brothers Company, Dayton, O.

1906. *KRANZ, W. G. Superintendent, Steel Casting Works, The National Malleable Castings Company, Sharon, Pa.

1896. *KREUZPOINTNER, PAUL. Pennsylvania Railroad, Altoona, Pa.

1904. KRUPP COMPANY, FRIED. Emil Ehrensberger, Director, Essen, Germany.

1908. LABORATORIO CENTRAL PARA EL ENSAYO DE MATERIALES. Escuela de Ingenieros de Caminos, Canales y Puertos, Madrid, Spain.

1903. LA CHICOTTE, H. A. Engineer in Charge, Manhattan Bridge (No. 3) and Blackwell's Island Bridge (No. 4), Park Row Building, New York, N. Y.

1905. *LACKAWANNA STEEL COMPANY. Franklin E. Abbott, Inspecting Engineer, Buffalo, N. Y.

1908. LAFAYETTE COLLEGE LIBRARY. J. F. Stonecipher, Librarian, Easton, Pa.

ELECTED.

1909. LAKE, EDWARD N. Division Engineer, Electrical Transmission and Distribution, 321 Center Street, Wheaton, Ill.

1906. LANE, H. C. Chief Draftsman, Maryland Steel Company, Sparrows Point, Md.

1909. LANGENBACH, E. A. Stark Rolling Mill Company, Canton, O.

1899. *LANZA, GAETANO. Professor of Theoretical and Applied Mechanics, in charge of Mechanical Engineering Department, Massachusetts Institute of Technology, Boston, Mass.

1904. *LARNED, E. S. Manager, United Building Materials Company, 101 Milk Street, Boston, Mass.

1903. LARSSON, C. G. E. Assistant Chief Engineer, American Bridge Company of New York, 30 Church Street, New York, N. Y.

1907. LAWSON, THOMAS R. Associate Professor of Rational and Technical Mechanics, Rensselaer Polytechnic Institute, 99 Twelfth Street, Troy, N. Y.

1908. LAZELL, E. W. Consulting Engineer, Charles Warner Company, 1313 West Ninth Street, Wilmington, Del.

1909. *LEE, ERNEST EUGENE. Assistant Electrical and Mechanical Engineer, Culebra, Canal Zone.

1910. LEIBFRIED, J. E. Cement Expert, United States Reclamation Service, 408 Commonwealth Building, Denver, Colo.

1906. LEIDEL, HENRY. Factory Superintendent, Banzai Manufacturing Company, 331 Chestnut Street, Richmond Hill, N. Y.

1898. *LESLEY, ROBERT W. (*Vice-President*). President, American Cement Company, Pennsylvania Building, Philadelphia, Pa.

1903. LEWIS, FREDERICK H. Consulting Engineer, Leeds, Ala.

1905. LEWIS, JOHN F. Chief Inspector, Duquesne Steel Works, Carnegie Steel Company, Duquesne, Pa.

1907. LEWIS, RANSOME T. Manager, Elmira Plant, Empire Bridge Company, 412 West Clinton Street, Elmira, N. Y.

1904. *LIDGERWOOD, JOHN H., JR. Engineer, Lidgerwood Manufacturing Company, 96 Liberty Street, New York, N. Y.

1908. ‡LINCOLN, H. J. Inspector, Atchison, Topeka, and Santa Fé Railway, 407 Ross Avenue, Wilkinsburg, Pa.

ELECTED.

1910. LINCOLN, JOHN H. Bridge Inspector, 62 Lewis Avenue, East Lansdowne, Pa.

1910. *LINDAU, A. E. Chief Engineer, Corrugated Bar Company, Bank of Commerce Building, St. Louis, Mo.

1909. *LINDER, OSCAR. Chief of Testing Laboratories, Western Electric Company, Hawthorne, Ill.

1909. *LINDHARD, P. T. Secretary, F. L. Smidth Company, 50 Church Street, New York, N. Y.

1909. *LIPSCY, THOMAS E. L. Assistant Engineer, Culebra, Canal Zone.

1903. *LITTLE, A. D. Chemical Expert and Engineer, 93 Broad Street, Boston, Mass.

1908. LITTLE, CHARLES N. Professor of Civil Engineering, Idaho State University, 818 Elm Street, Moscow, Idaho.

1905. LLOYD, JOHN. Banker and Coal Operator, Altoona, Pa.

1903. LOBDELL, W. W. President, Lobdell Car Wheel Company, Wilmington, Del.

1902. LOBER, J. B. President, Vulcanite Portland Cement Company, Land Title Building, Philadelphia, Pa.

1909. LOCKE INSULATOR MANUFACTURING COMPANY, THE. Walker T. Goddard, Electrical Engineer, Victor, N. Y.

1908. LOCKWOOD, GREENE AND COMPANY. Architects and Engineers for Industrial Plants, 93 Federal Street, Boston, Mass.

1908. LOCKWOOD, J. B. C. Consulting Engineer, 507 Lumber Exchange Building, Portland, Ore.

1908. ‡LOEPSINGER, ALBERT J. Laboratory Engineer, General Fire Extinguisher Company, 41 Atlantic Avenue, Providence, R. I.

1905. *LOHMANN, H. W. Manager, James Stewart and Company, Engineers and Contractors, 302 Lincoln Trust Building, St. Louis, Mo.

1905. LONG, E. McLEAN. Civil Engineer, Inspector of Steel, 220 Broadway, New York, N. Y.

1904. *LONG, R. A. President and General Manager, The Long-Bell Lumber Company, Keith and Perry Building, Kansas City, Mo.

1903. LORDLY, HENRY ROBERTSON. Engineer in Charge, Lachine Canal, Blacks Bridge, Canada.

1909. *LOUDENBECK, HARRY C. Chief Chemist, Westinghouse Air Brake Company, Wilmerding, Pa.

ELECTED.

1908. *LOVELL, ALFRED. Consulting Engineer, 819 Harrison Building, Philadelphia, Pa.

1910. LOW, FRANK S. Director, Experimental and Research Department, Patton Paint Company, 215-231 Lake Street, Milwaukee, Wis.

1906. LOW, WILSON H. Head Chemist, The Cudahy Packing Company, South Omaha, Neb.

1899. LOWE BROTHERS COMPANY, THE. Paint and Color Makers. Houston Lowe, President, Dayton, O.

1900. LOWETH, CHARLES F. Engineer and Superintendent of Bridges and Buildings, Chicago, Milwaukee and St. Paul Railway, 1232 Railway Exchange, Chicago, Ill.

1907. *LOWTHER, BURTON. Constructing Engineer, Water Works Department, 2608 Brooklyn Avenue, Kansas City, Mo.

1908. LUCAS AND COMPANY, JOHN. F. A. Lane, Gibbsboro, N. J.

1909. *LUDLOW VALVE MANUFACTURING COMPANY. James H. Caldwell, Vice-President, Troy, N. Y.

1908. *LUEHRS, DANIEL M. Mechanical Engineer, McCreery Engineering Company, Toledo, O.

1905. LUKENS, ALAN N. Mechanical Engineer, Railway Steel Spring Company, 71 Broadway, New York, N. Y.

1902. *LUKENS IRON AND STEEL COMPANY. Charles L. Huston, Vice-President, Coatesville, Pa.

1906. LUM, D. W. Chief Engineer, Maintenance of Way, Southern Railway Company, Washington, D. C.

1898. *LUNDTEIGEN, ANDREAS. Chemist, Peerless Portland Cement Company, Union City, Mich.

1906. LYNCH, THOMAS. President, H. C. Frick Coke Company, Carnegie Building, Pittsburg, Pa.

1902. *LYNCH, T. D. Engineer of Material Tests, Westinghouse Electric and Manufacturing Company, East Pittsburg, Pa.

1910. *LYON, FRANK. Lieutenant-Commander, United States Navy, 50 Franklin Street, Annapolis, Md.

1910. *MACGREGOR, JAMES S. Instructor in Civil Engineering, Columbia University, New York, N. Y.

1904. *MACK, J. LATHROP. Box 83, Rockmart, Ga.

1908. MACKAY, H. M. Associate Professor of Civil Engineering, McGill University, Montreal, Canada.

ELECTED.

1895. *MACLAY, WILLIAM W. Consulting Engineer, 102 Erskine Street, Detroit, Mich.

1910. MACNAB, S. D. Superintendent of Tests of Materials, McGill University, Montreal, Canada.

1909. MACNICHOL, CHARLES. Master Painter, 428 Tenth Street, Washington, D. C.

1902. MACPHERRAN, R. S. Chemist, Allis-Chalmers Company, West Allis Works, Milwaukee, Wis.

1904. MAHON, R. W. Chemist, New York Central and Hudson River Railroad, West Albany, N. Y.

1907. MAIN, WILLIAM. Consulting Engineer and Chemist, 100 Broadway, New York, N. Y.

1902. MAJOR, CHARLES. President, A. and P. Roberts Company; Manager, Pencoyd Iron Works, Pencoyd, Pa.

1908. MANNHARDT, HANS. Chief Chemist, Heath and Milligan Manufacturing Company, 1104 Oakdale Avenue, Chicago, Ill.

1907. MANSFIELD, ARTHUR N. Engineering Department, American Telephone and Telegraph Company, 15 Dey Street, New York, N. Y.

1898. *MARBURG, EDGAR (*Secretary-Treasurer*). Professor of Civil Engineering, University of Pennsylvania, Philadelphia, Pa.

1906. MARIS, JOHN M. Principal, School of Structural Engineering, International Correspondence Schools, Scranton, Pa.

1905. *MARQUETTE CEMENT MANUFACTURING COMPANY. T. G. Dickinson, General Manager, La Salle, Ill.

1907. MARSH, C. P. Assistant to Engineer of Structures, New York Central and Hudson River Railroad, Room 1201, 335 Madison Avenue, New York, N. Y.

1906. MARSHALL, WILLIAM. President, The Anglo-American Varnish Company, 53 Johnson Street, Newark, N. J.

1905. MARSTEN, A. Dean of Division of Engineering, Iowa State College, Ames, Iowa.

1907. MARTIN, EDGAR D. Architect, 172 Washington Street, Chicago, Ill.

1902. MARTIN, SIMON S. Superintendent, Maryland Steel Company, Sparrows Point, Md.

1907. MARVIN, F. O. Dean, School of Engineering, University of Kansas, Lawrence, Kan.

1908. ‡MASTERS, FRANK M. Pittsburg Representative of Ralph Mojeski, 607 Arnott Building, Pittsburg, Pa.

ELECTED.

1903. MASTERS, J. B. Inspecting Engineer, Pittsburg Representative of Hildreth and Company, 506 North St. Clair Street, Pittsburg, Pa.

1906. MASURY AND SON, JOHN W. 44 Jay Street, Brooklyn, N. Y.

1902. MATCHAM, CHARLES A. Vice-President and General Manager, Allentown Portland Cement Company, Allentown, Pa.

1903. *MATHEWS, JOHN A. Operating Manager and General Superintendent, Halcomb Steel Company, Syracuse, N. Y.

1904. *MAURER, E. R. Professor of Mechanics, University of Wisconsin, Madison, Wis.

1896. MCCAULEY, H. K. Secretary and Treasurer, Altoona Iron Company, Altoona, Pa.

1907. *MCCLEARY, E. T. Chief Chemist, Youngstown Sheet and Tube Company, Youngstown, O.

1906. MCCORMACK, HARRY M. Professor of Chemical Engineering, Armour Institute of Technology, Chicago, Ill.

1905. MCCREA, ARCHIBALD M. President, Union Spring and Manufacturing Company, Farmers' Bank Building, Pittsburg, Pa.

1903. *MCCREADY, ERNEST B. General Manager, Lehigh Valley Testing Laboratory, Fourth and Linden Streets, Allentown, Pa.

1908. MCCREATH AND SON, ANDREW S. Chemists, 121 Market Street, Harrisburg, Pa.

1909. *MCCULLOCH, JOHN A. Mechanical Engineer, 1111 Park Street, McKeesport, Pa.

1910. MCDONNELL, M. E. Chemist and Bacteriologist, Pennsylvania Railroad Company, Altoona, Pa.

1907. *MCFARLAND, G. S. Chemist, Gordon, Wyman and Company, Worcester, Mass.

1903. MCGILL UNIVERSITY, FACULTY OF APPLIED SCIENCE. Henry T. Bovey, Dean, Montreal, Canada.

1905. MCGRADY, J. W. Chief Inspector, Homestead Steel Works, Carnegie Steel Company, Munhall, Pa.

1907. MCGUIRE, JAMES C. Civil Engineer, 26 Cortlandt Street, New York, N. Y.

1906. MCILHINEY, PARKER C. Consulting Chemist, 7 East Forty-second Street, New York, N. Y.

ELECTED.

1896. *McKENNA, CHARLES F. Chemist, 1553 Hudson Terminal Building, 50 Church Street, New York, N. Y.

1909. ‡McKENZIE, HERMAN E. Engineer of Timber Tests, Forest Service, Washington, D. C.

1905. McKIBBEN, FRANK P. Professor of Civil Engineering, Lehigh University, South Bethlehem, Pa.

1902. *McLEOD, JOHN. Assistant to President, Carnegie Steel Company, Pittsburg, Pa.

1909. McLURE, NORMAN R. Resident Engineer, Phœnix Bridge Company and Phœnix Iron Company, 527 Pierce Building, St. Louis, Mo.

1904. *McNAUGHER, D. W. Civil Engineer, Monongahela Bank Building, Pittsburg, Pa.

1907. McNAUGHTON, J. P. General Sales Agent, Dominion Iron and Steel Company, Sydney, Nova Scotia.

1904. *MEAD, CHARLES ADRIANCE. Engineer of Bridges, Board of Railroad Commissioners of the State of New Jersey, 165 Wildwood Avenue, Upper Montclair, N. J.

1899. MEADE, RICHARD K. Director, Meade Testing Laboratories, 403 Allentown Bank Building, Allentown, Pa.

1902. MEIER, E. D. President and Chief Engineer, Herne Safety Boiler Company, 11 Broadway, New York, N. Y.

1910. *MERIWETHER, COLEMAN. President and Chief Engineer, Lock Joint Pipe Company, 165 Broadway, New York, N. Y.

1909. MERRILL, O. C. Hydraulic and Sanitary Engineer, 3008 Benvenue Avenue, Berkeley, Cal.

1895. *MERRIMAN, MANSFIELD (*Past President*). Consulting Engineer, The Engineers' Club, 32 West Fortieth Street, New York, N. Y.

1909. *METAL INDUSTRY, THE. Palmer H. Langdon, Editor and Publisher, 61 Beekman Street, New York, N. Y.

1910. *MICHAELIS, W., JR. Consulting Engineer for the *Cement Industry*, Schiller Building, Chicago, Ill.

1909. *MIDVALE STEEL COMPANY. Radclyffe Furness, Engineer in charge of Research, Philadelphia, Pa.

1903. MILLER, JOHN S., JR. Road Department, Barber Asphalt Paving Company, Land Title Building, Philadelphia, Pa.

1903. MILLER, RUDOLPH P. Superintendent of Buildings, Borough of Manhattan, 220 Fourth Avenue, New York, N. Y.

1900. MILLS, CHARLES M. Consulting Engineer, Room 415, 71 Broadway, New York, N. Y.

ELECTED.

1910. *MILLWOOD, JAMES P. Chemist, United States Navy Yard, 246 Willoughby Avenue, Brooklyn, N. Y.

1909. *MILWAUKEE ELECTRIC RAILWAY AND LIGHT COMPANY. John I. Beggs, President and General Manager, Milwaukee, Wis.

1910. *MISSOURI PACIFIC RAILWAY COMPANY. H. E. Hale, Engineer of Design, St. Louis, Mo.

1907. MITCHELL, A. E. Vice-President, The Wychoff Pipe and Creosoting Company, Incorporated, 50 Church Street, New York, N. Y.

1907. MITCHELL, ROBERT. General Sales Agent, Pennsylvania, Beech Creek and Eastern Coal Company, Land Title Building, Philadelphia, Pa.

1903. *MOISSEIFF, LEON S. Assistant Engineer to Commissioner of Bridges, 13 Park Row, New York, N. Y.

1896. *MOLDENKE, RICHARD. Metallurgist, Consulting Engineer, Watchung, N. J.

1908. MOLLESON, GEORGE E. Manager, Railroad Department, Tyler Tube and Pipe Company, 50 Church Street, New York, N. Y.

1906. MONTANA COLLEGE OF AGRICULTURE AND MECHANIC ARTS. Bozeman, Mont.

1903. MOORE, HERBERT F. Assistant Professor of Theoretic and Applied Mechanics, University of Illinois, 710 Hill Street, Champaign, Ill.

1909. ‡MOORE, JOSEPH K. Ceramic Engineer and Chemist, Pacific Clay Products Bureau, 701 Lowman Building, Seattle, Wash.

1902. MOORE, WILLIAM HARLEY. Engineer of Bridges, New York, New Haven and Hartford Railroad, New Haven, Conn.

1905. MORGAN CONSTRUCTION COMPANY. Victor E. Edwards, Mechanical Engineer, Worcester, Mass.

1909. *MORRIS, D. A. Metallurgical Engineer, Nelson Valve Company, Chestnut Hill, Philadelphia, Pa.

1905. *MORRISON, HUGH S. Mechanical Engineer, Mutual Assurance Society Building, Richmond, Va.

1910. *MORSE, F. B. District Manager, Gulick-Henderson Company, 30 Church Street, New York, N. Y.

1910. *MORSE, ROBERT G. Assistant Treasurer, Massachusetts Steel Casting Company, Everett, Mass.

1904. MOSELEY, ALEXANDER W. Professor of Applied Mechanics, Lewis Institute, Chicago, Ill.

ELECTED.

1907. MOTION, JOHN. Assistant Superintendent, Paint and Laboratory Department, The Joseph Dixon Crucible Company, Jersey City, N. J.

1906. MOULTON, MACE. Consulting Engineer, 150 Nassau Street, New York, N. Y.

1909. MOULTON, MACE, JR. Civil Engineer, 150 Nassau Street, New York, N. Y.

1909. MOYER, ALBERT. Manager, Sales Department, Vulcanite Portland Cement Company, 175 Fifth Avenue, New York, N. Y.

1909. MUCKENFUSS, A. M. Professor, University of Mississippi, University, Miss.

1904. MUDGE, H. U. Second Vice-President, Chicago, Rock Island and Pacific Railway Company, La Salle Street Station, Chicago, Ill.

1899. *MUESER, WILLIAM. Civil Engineer; Member, Concrete Steel Engineering Company, 13–21 Park Row Building, New York, N. Y.

1908. *MUHLFELD, JOHN E. General Superintendent of Motive Power, Baltimore and Ohio Railroad Company, Baltimore, Md.

1903. MUNROE, CHARLES EDWARD. Head Professor of Chemistry, George Washington University, Washington, D. C.

1904. MUNSELL, A. W. Inspector of Materials, Detroit River Tunnel Company, Detroit, Mich.

1908. MUNSELL, J. A. Assistant Cement Inspector, Erie Railroad, Ninth and Provost Streets, Jersey City, N. J.

1910. MURPHY, DANIEL H. President, American Conduit Manufacturing Company, 1402 Keystone Building, Pittsburg, Pa.

1908. MURRAY, FREDERIC L. 244 Brighton Street, Belmont, Mass.

1910. MURTAUGH, M. M. Consulting Hydraulic and Construction Engineer, Alta Club, Salt Lake City, Utah.

1899. MUTUAL BOILER INSURANCE COMPANY. 31 Milk Street, Boston, Mass.

1910. ‡MYERS, J. E. Chemist, New York State Highway Commission, 81 Lancaster Street, Albany, N. Y.

1908. NATIONAL CASH REGISTER COMPANY, THE. Manufacturers of Cash Registers. E. A. Deeds, Second Vice-President, Dayton, O.

ELECTED.

1905. NATIONAL FIREPROOFING COMPANY. E. V. Johnson, Vice-President and Western Manager, 806 Hartford Building, Chicago, Ill.

1900. *NATIONAL TUBE COMPANY. Frank N. Speller, Metallurgical Engineer, Frick Building, Pittsburg, Pa.

1909. NEAL, A. F. Chemist, Acme White Lead and Color Works, Detroit, Mich.

1909. NEAL, C. S. Secretary and General Manager, Acme White Lead and Color Works, Detroit, Mich.

1902. *NEFF, F. H. Professor of Civil Engineering, Case School of Applied Science, Cleveland, O.

1909. NEGUS, ARTHUR I. Superintendent, Construction Department, Malden and Melrose Gaslight Company, Malden, Mass.

1904. *NELSON, E. D. Engineer of Tests, Pennsylvania Railroad Company, Altoona, Pa.

1910. NELSON, GEORGE. City Engineer, Hermosa Beach, Cal.

1906. NETTLETON, W. A. General Superintendent, Motive Power, Chicago, Rock Island and Pacific Railway Company, La Salle Street Station, Chicago, Ill.

1898. *NEWBERRY, SPENCER B. Manager, Sandusky Portland Cement Company, Sandusky, O.

1905. NEWELL, F. H. Chief Engineer, United States Reclamation Service, 1330 F Street, Washington, D. C.

1909. ‡NEWHALL, CHARLES A. Chief Chemist, Superior Portland Cement Company, Baker, Wash.

1909. *NEW JERSEY ZINC COMPANY. F. E. Pierce, Engineer, 55 Wall Street, New York, N. Y.

1904. NEW YORK FIRE INSURANCE EXCHANGE. Henry E. Hess, Manager, 32 Nassau Street, New York, N. Y.

1907. NIMMO, J. V. Care of Canadian Northern Pacific Railway, Burns Building, 18 Hastings Street, W., Vancouver, B. C.

1902. *NORRIS, GEORGE L. Engineer of Tests, American Vanadium Company, Frick Building, Pittsburg, Pa.

1903. NORTON, C. L. Assistant Professor of Heat Measurement, Massachusetts Institute of Technology, Boston, Mass.

1909. *NOVELLA, CHARLES F. Engineer, Guatemala City, Guatemala.

1907. NUGENT, JOHN W. Librarian, Rensselaer Polytechnic Institute, 30 Second Street, Troy, N. Y.

ELECTED.

1909. *OBER, JULIUS E. Metallurgist and Chemist, 222 North Craig Street, Pittsburg, Pa.

1908. O'HARA, J. M. Official Cement Tester, Southern Pacific Company, 1109 Flood Building, San Francisco, Cal.

1898. *OLSEN, TINIUS. Tinius Olsen and Company, Testing Machines, 500 North Twelfth Street, Philadelphia, Pa.

1903. ORFORD COPPER COMPANY. H. E. Flewellin, 43 Exchange Place, New York, N. Y.

1902. ORTON, EDWARD, JR. Dean, College of Engineering, Ohio State University; State Geologist of Ohio, Columbus, O.

1898. OSBORN ENGINEERING COMPANY, THE. Frank C. Osborn, Cleveland, O.

1907. OSBORNE, RAYMOND GAYLORD. Inspector of Cement, 401 West Twenty-third Street, Los Angeles, Cal.

1903. *OSTROM, JOHN N. Bridge Engineer, 1518 Farmers' Bank Building, Pittsburg, Pa.

1904. *OTIS, SPENCER. Mechanical Engineer, 1707 Railway Exchange Building, Chicago, Ill.

1902. OUTERBRIDGE, ALEXANDER E., JR. Chemist and Metallurgist, 1600 Hamilton Street, Philadelphia, Pa.

1904. *OWEN, JAMES. Civil Engineer, 196 Market Street, Newark, N. J.

1903. PAGE, LOGAN WALLER. Director, Office of Public Roads, United States Department of Agriculture, Washington, D. C.

1909. ‡PAGE, W. MARSHALL. Engineer, 305 Pennsylvania Building, Philadelphia, Pa.

1908. PAGE, WILLIAM NELSON. President, Gauley Mountain Coal Company, Ansted, W. Va.

1909. PAINT AND VARNISH SOCIETY, THE. St. Bride's Institute, Fleet Street, E. C., London, England.

1909. PARKS, A. M. President, A. M. Parks Company, 645 The Bourse, Philadelphia, Pa.

1908. *PARR, S. W. Professor of Applied Chemistry, University of Illinois, Urbana, Ill.

1909. PATTON, J. E., JR. General Paint Manager, Pittsburg Plate Glass Company, 1628 Frick Building, Pittsburg, Pa.

1906. PATTON, LUDINGTON. Secretary-Treasurer, Patton Paint Company, Milwaukee, Wis.

1908. PAUL, CHARLES E. Care of Armour Institute, Chicago, Ill.

ELECTED.

1906. PAYNE, HENRY. Professor of Engineering, University of Melbourne, Melbourne, Australia.

1908. PAYNE, T. P. Contracting Engineer, Berlin Construction Company, Stair Building, Toronto, Canada.

1896. PEASE, F. N. Chemist, Pennsylvania Railroad, P. O. Box 503, Altoona, Pa.

1908. PECK AND COMPANY, FRANCIS J. Mining Engineers and Chemists, 731-735 Williamson Building, Cleveland, O.

1903. PECKITT, LEONARD. President, Empire Steel and Iron Company, Catasauqua, Pa.

1909. PENNSYLVANIA CRUSHER COMPANY. G. W. Borton, General Manager, Stephen Girard Building, Philadelphia, Pa.

1902. PENNSYLVANIA STEEL COMPANY, THE. J. V. W. Reynders, Vice-President, Steelton, Pa.

1908. *PENNY, EDGAR. Vice-President and General Manager, Newburgh Ice Machine and Engine Company, Newburgh, N. Y.

1906. PEPPEL, S. V. Chemical Engineer, 2437 South Robey Street, Chicago, Ill.

1910. PERKINS, GEORGE H. Superintendent of Refineries, Warren Brothers Company, Boston, Mass. *For Mail:* 5 Irving Terrace, Cambridge, Mass.

1904. *PERLEY, GEORGE E. Cement Expert, Department of Public Works, Ottawa, Canada.

1907. PERRY, R. S. President, Harrison Brother and Company, Incorporated, Philadelphia, Pa.

1905. PETERS, J. M. Secretary, Matheson Lead Company, 182 Front Street, New York, N. Y.

1907. PETTEE, EUGENE E. Civil Engineer, J. R. Worcester Company, 79 Milk Street, Boston, Mass.

1905. *PEW, J. HOWARD. Assistant Manager of Refinery, Sun Company, Marcus Hook, Pa.

1910. PHILLIPS, ASA EMORY. Superintendent Sewer Department, District of Columbia, District Building, Washington, D. C.

1910. PHILLIPS, W. R. Mechanical Engineer, 419 Lumber Exchange Building, Portland, Ore.

1909. PICKARD, GLENN H. Chemist to Spencer Kellogg Company, Buffalo, N. Y.

1903. *PINCHOT, GIFFORD. Washington, D. C.

1910. *PINKERTON, ANDREW. Electrical Engineer, American Sheet and Tin Plate Company, 1007 Frick Building, Pittsburg, Pa.

ELECTED.

1908. PIPER, H. D. Care of Diamond Chain and Manufacturing Company, Indianapolis, Ind.

1904. *PITTSBURG FORGE AND IRON COMPANY. W. I. Miller, Secretary, Pittsburg, Pa.

1905. *PITTSBURG TESTING LABORATORY. John M. Bailey, Secretary, 325 Water Street, Pittsburg, Pa.

1910. *PLATT IRON WORKS COMPANY, THE. R. W. Grace, General Superintendent, Dayton, O.

1910. PLOCK, A. F. Chief Engineer, The Northwestern Iron Company, Mayville, Wis.

1910. ‡PLUMB, R. ALFRED. Director, Michigan Technical Laboratory, 58 Lafayette Avenue, Detroit, Mich.

1902. POLK, ANDERSON. Associated with the Lowe Brothers Company, Dayton, O. *For Mail:* The Engineers' Club, 32 West Fortieth Street, New York, N. Y.

1906. POLSON, JOSEPH A. Post Office Box 166, Agricultural College, Mich.

1904. *POMEROY, LEWIS R. Special Representative, Railway Department, General Electric Company, 44 Broad Street, New York, N. Y.

1908. POORMAN, ALFRED P. Instructor in Civil Engineering, University of Colorado, Boulder, Colo.

1909. ‡POPE, GEORGE S. Assistant Engineer, Technologic Branch, United States Geological Survey, Washington, D. C.

1898. PORTER, JAMES MADISON. Professor of Civil Engineering, Lafayette College, Easton, Pa.

1910. POST, W. C. Metallurgical Engineer, Illinois Steel Company, South Works, South Chicago, Ill.

1907. POTTS, STEPHEN C. Assistant Chemist, Pennsylvania Railroad. *For Mail:* 2413 Broad Avenue, Altoona, Pa.

1903. *POWERS, W. A. Chief Chemist, Atchison, Topeka and Santa Fé Railroad, Topeka, Kan.

1904. *PRENTISS, GEORGE N. Chemist, Chicago, Milwaukee and St. Paul Railway, 226 Thirty-third Street, Milwaukee, Wis.

1904. PRESTON, S. R. 370 Elm Street, Westmount, Canada.

1909. ‡PRETSCH, CHARLES J. Resident Inspector, Pittsburg Testing Laboratories, 317 Walnut Street, Harrisburg, Pa.

1909. *PRICE, CHARLES P. Manager, American Tar Company, P. O. Box 65, Malden, Mass.

1903. PRICE, MORTON MOORE. Sales Agent, Babcock and Wilcox Company, North American Building, Philadelphia, Pa.

ELECTED.

1905. *PROVOST, ANDREW J., JR. Sanitary Expert and Hydraulic Engineer, 39 West Thirty-eighth Street, New York, N. Y.

1908. *PRYOR, FREDERICK L. Professor of Experimental Engineering, Stevens Institute, Hoboken, N. J.

1904. PURDON, C. D. Chief Engineer, Cotton Belt Railroad, 6157 Kingsbury Boulevard, St. Louis, Mo.

1908. PURDUE UNIVERSITY LIBRARY. W. M. Hepburn, Librarian, Lafayette, Ind.

1903. QUIMBY, H. H. Assistant Engineer of Bridges, Bureau of Surveys, 3920 Girard Avenue, Philadelphia, Pa.

1909. RADER, B. H. Eastern Sales Agent, Universal Portland Cement Company, 524 Frick Building, Pittsburg, Pa.

1902. RAILWAY AND ENGINEERING REVIEW. W. M. Camp, Editor, 1305 Manhattan Building, Chicago, Ill.

1904. RAMAGE, J. C. Superintendent of Tests, Southern Railway Company, Alexandria, Va.

1904. RAMSAY, H. MARTYN. General Inspector, Pennsylvania Railroad Company, Altoona, Pa.

1908. RANDALL, D. T. Mechanical Engineer, with A. D. Little Company, Incorporated, 93 Broad Street, Boston, Mass.

1907. RAQUET, E. H. Chief Chemist, New York, New Haven and Hartford Railroad Company, West Haven, Conn.

1909. RAYMOND CONCRETE PILE COMPANY. Maxwell M. Upson, Secretary and General Manager, 140 Cedar Street, New York, N. Y.

1909. RAYMOND, M. Assistant Engineer, Department of Docks, 478 Central Park, West, New York, N. Y.

1902. READING IRON COMPANY. George Schuhman, Vice-President and General Manager, Reading, Pa.

1910. ‡RECTANUS, S. R. Chief Chemist, Galvanizing Department, American Rolling Mills Company, Middletown, O.

1904. REEVE, C. S. Assistant Chemist, Office of Public Roads, United States Department of Agriculture, Washington, D. C.

1908. *REMINGTON ARMS COMPANY. Nathan A. Chase, Chemist, Box 115, Ilion, N. Y.

ELECTED.

1909. ‡RENINGER, HENRY A. Chemist, Lehigh Portland Cement Company, Allentown, Pa.

1906. REYNDERS, J. V. W. Vice-President, Pennsylvania Steel Company, Steelton, Pa.

1910. RHODES, T. ECKFORD. Chief Engineer, Whitney-Steen Company, 1 Liberty Street, New York, N. Y.

1898. RICE, FRANCIS S. Engineer of Bridges, St. Louis and San Francisco Railroad Company, 943 Frisco Building, St. Louis, Mo.

1908. RICE, GEORGE S. Mining Engineer, United States Geological Survey, Pittsburg, Pa.

1909. RICE, H. A. Associate Professor of Civil Engineering, University of Kansas, 1233 Massachusetts Street, Lawrence, Kan.

1900. RICHARDS, JOSEPH T. Chief Engineer, Maintenance of Way, Pennsylvania Railroad, Broad Street Station, Philadelphia, Pa.

1902. *RICHARDS, JOSEPH W. Professor of Metallurgy, Lehigh University, South Bethlehem, Pa.

1902. *RICHARDS, ROBERT H. Professor of Mining Engineering and Metallurgy, Massachusetts Institute of Technology, Boston, Mass.

1896. *RICHARDSON, CLIFFORD. Asphalt Expert, New York Testing Laboratory, 30 Church Street, New York, N. Y.

1910. *‡RIEGER, WILLIAM H. Chemist, Heppenstall Forge and Knife Company, Pittsburg, Pa.

1902. RIEGNER, W. B. Engineer of Bridges, Philadelphia and Reading Railway, Reading Terminal, Philadelphia, Pa.

1898. *RIEHLÉ, FREDERICK A. Riehlé Brothers Testing Machine Company, 1424 North Ninth Street, Philadelphia, Pa.

1910. RIGG, GILBERT. Chemist, Head of Research Department, New Jersey Zinc Company, Palmerton, Pa.

1908. RIGHTS, LEWIS D. Civil Engineer, care of L. F. Shoemaker and Company, 45 Broadway, New York, N. Y.

1906. RILEY, GEORGE N. National Tube Company, Frick Building, Pittsburg, Pa.

1907. *RINALD, C. D. Rinald Brothers, Paint Manufacturers, 1142 North Hancock Street, Philadelphia, Pa.

1907. ‡RISTINE, JOHN D. Railway Representative, The Lowe Brothers Company, 470 The Rookery, Chicago, Ill.

1909. RITTER, DANIEL E. Assistant to President, Lehigh Portland Cement Company, Allentown, Pa.

ELECTED.

1904. *ROBERTS, ALFRED E. Analytical and Consulting Chemist and Metallurgist, Bull and Roberts, 100 Maiden Lane, New York, N. Y.

1908. ROBERTS, J. C. Assistant Chief Engineer, United States Geological Survey, Pittsburg, Pa.

1908. ROBERTS AND SCHAEFER COMPANY. Consulting Engineers and Contractors. Frank E. Mueller, Secretary, 1270 Old Colony Building, Chicago, Ill.

1904. ROBERTSON, LESLIE S. Secretary of the Engineering Standards Committee, 28 Victoria Street, London, England.

1904. *ROBINSON, A. F. Bridge Engineer, Atchison, Topeka and Santa Fé Railway System, 1000 Railway Exchange Building, Chicago, Ill.

1908. ROBINSON, A. L. Electrical Engineer, Isthmian Canal Commission, Culebra, Canal Zone.

1908. ROBINSON, C. SNELLING. Second Vice-President, Youngstown Sheet and Tube Company, Youngstown, O.

1910. ROBINSON, DWIGHT E. Salesman, Acme White Lead and Color Works, 54 East Sixty-sixth Street, New York, N. Y.

1908. ROBINSON, F. W. Superintendent of Plants, Pratt and Lambert, 79 Tonawanda Street, Buffalo, N. Y.

1910. ROBINSON, G. P. Inspector of Locomotive Boilers, Public Service Commission, 8 Chestnut Street, Albany, N. Y.

1904. *ROCK PRODUCTS. Fred K. Irvine, Technical Editor, 431 West Main Street, Louisville, Ky.

1906. RODGERS, S. M. Superintendent, North Works, American Steel and Wire Company, Worcester, Mass.

1909. *RODMAN, H. B. Chemist, Pennsylvania Tunnel and Terminal Railroad Company, 345 East Thirty-third Street, New York, N. Y.

1900. *ROEBLING'S SONS COMPANY, JOHN A. H. J. Horne, Assistant Superintendent, Department of Wire-drawing, Trenton, N. J.

1910. ROGERS, ALLEN. In charge of Industrial Chemistry, Pratt Institute, Brooklyn, N. Y.

1907. ROMAN, B. OLIVER Y. Ingeniero de Caminos, Canales y Puertos, Laboratorio Central para el Ensayo de Materieles, Calle de Alarcon, 1, Madrid, Spain.

1905. *ROSENHEIM, A. F. Architect, H. W. Hellman Building, Los Angeles, Cal.

ELECTED.

1905. *ROSSI, JAMES C. General Superintendent, National Fireproofing Company, 71 Lewis Street, Perth Amboy, N. J.

1909. ‡ROTE, JOHN G. Manager, Gillette Safety-Razor Company, First and Colton Streets, Boston, Mass.

1910. ‡ROWLAND, WILLIAM S. Chemical Engineer, The Stanley Works, New Britain, Conn.

1910. ROWLANDS, D. DWIGHT. Chief Engineer, Rider-Lewis Motor Car Company, Anderson, Ind.

1903. ROYAL, JOSEPH. Inspecting Engineer, 1015 Harrison Building, Philadelphia, Pa.

1906. RUGGLES, WILLIAM B. Mechanical Engineer, 39 Cortlandt Street, New York, N. Y.

1908. ‡RUPP, MANNING E. Resident Engineer, Balboa, Canal Zone.

1910. ‡RUSSELL, A. A. M. Assistant Chemist, Board of Public Works, 349 Frederick Street, San Francisco, Cal.

1906. *RUSSELL, ERNEST JOHN. Architect, Chemical Building, St. Louis, Mo.

1909. RUST, ROBERT R. Superintendent of Foundries, Central Foundry Company, 37 Wall Street, New York, N. Y.

1904. RUTHENBURG, MARCUS. Metallurgical Engineer, Electrical Federation Offices, Kingsway, London, W. C., England.

1908. RYERSON AND SON, JOSEPH T. Iron and Steel. Edward T. Hendee, Sixteenth and Rockwell Streets, Chicago, Ill.

1908. *RYS, C. Metallurgist, 521 Carnegie Building, Pittsburg, Pa.

1898. SABIN, A. H. Chemist, 432 Sanford Avenue, Flushing, N. Y.

1902. SABIN, L. C. General Superintendent, St. Mary's Falls Canal, Sault Ste. Marie, Mich.

1908. SAEGER, CHARLES M. General Manager, Coplay Cement Manufacturing Company, 1320 Hamilton Street, Allentown, Pa.

1909. *‡SAKLATWALLA, B. Metallurgist, American Vanadium Company, 227 Halket Street, Pittsburg, Pa.

1904. *SALMON, FREDERICK W. Civil and Mechanical Engineer, 127 South Central Avenue, Burlington, Iowa.

1910. SANBORN, JOHN R. Engineer, Westinghouse Electric and Manufacturing Company, 123 North Negley Avenue, Pittsburg, Pa.

ELECTED.

1909. *SANG, ALFRED. Consulting Engineer, 96 Boulevard de Versailles, St. Cloud (S. and O.), France.

1910. ‡SANGER, F. M., JR. Assistant Superintendent, Tyler Tube and Pipe Company, Washington, Pa.

1908. SARGENT, FITZ WILLIAM. Chief Engineer, American Brake-Shoe and Foundry Company, Box 15, Mahwah, N. J.

1910. *SARGENT, GEORGE W. Fourth Vice-President, Crucible Steel Company of America, Empire Building, Pittsburg, Pa.

1902. *SAUNDERS, WALTER M. Analytical and Consulting Chemist, 184 Whittier Avenue, Providence, R. I.

1896. *SAUVEUR, ALBERT. Metallurgical Engineer; Professor of Metallurgy, Harvard University, Rotch Building, Cambridge, Mass.

1908. SAWYER, ARTHUR HENRY. Cement Inspector, The Hudson Manhattan Railroad Company, 98 Hudson Street, Jersey City, N. J.

1903. SCARBOROUGH, F. W. Mining Engineer, 816 Mutual Building, Richmond, Va.

1904. SCHADE, G. C. 314 West College Street, Canonsburg, Pa.

1908. SCHALL, FREDERICK E. Bridge Engineer, Lehigh Valley Railroad, South Bethlehem, Pa.

1907. *SCHEIDEL, A. Managing Director, The Commonwealth Portland Cement Company, Mutual Life of New York Building, Martin Place, Sydney, Australia.

1909. SCHENECTADY VARNISH COMPANY. W. H. Wright, Schenectady, N. Y.

1908. *SCHILDHAUER, EDWARD. Electrical and Mechanical Engineer, Isthmian Canal Commission, Department of Construction and Engineering, Culebra, Canal Zone.

1908. SCHLUEDERBERG, GEORGE W. Coal Operator, 210 West Craig Street, Pittsburg, Pa.

1909. SCHMIDT, CHARLES. Chief Engineer, Peerless Motor Car Company, Cleveland, O.

1904. *SCHMITT, F. E. Associate Editor, *Engineering News*, 220 Broadway, New York, N. Y.

1905. SCHNEIDER, C. C. Consulting Engineer, Pennsylvania Building, Philadelphia, Pa.

1900. SCHNEIDER, HERMAN. Professor of Civil Engineering, University of Cincinnati, Cincinnati, O.

ELECTED.

1906. SCHNELL, HARRY J. Editor and Manager, *Oil, Paint and Drug Reporter, The Druggists' Circular* and *The Painters' Magazine*, 100 William Street, New York, N. Y.

1905. *SCHNIEWIND, F. Consulting Chemical Engineer; Vice-President, The United Coke and Gas Company, 17 Battery Place, New York, N. Y.

1908. SCHOLZ, CARL. Manager, Mining Department, Chicago, Rock Island and Pacific Railway Company, Old Colony Building, Chicago, Ill.

1909. SCHRODTER, E. Secretary, Verein Deutscher Eisenhüttenleute, Düsseldorf 15 Jacobistrasse 3/5, Germany.

1902. SCHUERMAN, W. H. Dean of Engineering Department and Professor of Civil Engineering, Vanderbilt University, Nashville, Tenn.

1910. *SCHWARCMAN, ALEXANDER. Chemist, Spencer Kellogg and Sons, Buffalo, N. Y.

1905. SCHWARTZ, ARCHIE W. Inspector, Bureau of Buildings, Borough of Manhattan, 80 East Washington Square, New York, N. Y.

1907. SCHWARTZ, HARRY A. Chemist, The National Malleable Castings Company. *For Mail:* 522 Tibbs Avenue, Indianapolis, Ind.

1908. *SCOFIELD, H. H. Instructor in Testing Materials, Purdue University, 234 South Pierce Street, West Lafayette, Ind.

1907. SCOTT, DONALD G. James Stewart and Company, 14 South Newstead Avenue, St. Louis, Mo.

1904. *SCOTT, WILLIAM F. Structural Engineer, Dunnville, Canada.

1902. SCOTT, W. G. Consulting Chemist, 2627 North Robey Street, Chicago, Ill.

1905. SCRIBNER, C. E. Chief Engineer, Western Electric Company, 463 West Street, New York, N. Y.

1910. *‡SEABURY, RICHARD W. Secretary and Treasurer, Boonton Rubber Company, Box 423, Boonton, N. J.

1898. SEAMAN, HARRY J. Superintendent, Atlas Cement Company, Catasauqua, Pa.

1902. SEAMAN, HENRY B. Civil Engineer, 154 Nassau Street, New York, N. Y.

1906. SEARS, W. T. Engineering Bureau, Niles-Bement-Pond Company, Twenty-first and Callowhill Streets, Philadelphia, Pa.

1908. *SEAVER, J. W., JR. Civil Engineer, Waynesville, N. C.

ELECTED.

1910. ‡SELLERS, JAMES C., JR. Engineer of Tests, Standard Steel Works Company, Burnham, Pa.

1904. *SELLERS AND COMPANY, INCORPORATED, WILLIAM. Coleman Sellers, Jr., President, 1600 Hamilton Street, Philadelphia, Pa.

1910. SELLEW, WILLIAM H. Principal Assistant Engineer, Michigan Central Railroad, 82 Rowena Street, Detroit, Mich.

1906. *SEMET-SOLVAY COMPANY. O. S. Doolittle, Sales Agent, 17 Battery Place, New York, N. Y.

1909. SETZE, J. A. Manager of Sales, Northampton Portland Cement Company, 165 Broadway, New York, N. Y.

1902. *SHANKLAND, E. C. AND R. M. Civil Engineers, 1106 Rookery, Chicago, Ill.

1907. SHANNON, CHARLES. 617 Liberty Avenue, Pittsburg, Pa.

1910. SHARMAN, H. B. President, Ontario Metal Culvert Company, Guelph, Canada.

1909. SHARPLESS, PHILIP P. Chemist, 297 Franklin Street, Boston, Mass.

1904. ‡SHERMAN, HERBERT L. Sherman and Edwards, Chemical Engineers, 12 Pearl Street, Boston, Mass.

1906. SHERRERD, JOHN M. General Sales Agent, Taylor Iron and Steel Company, High Bridge, N. J.

1903. SHERRERD, MORRIS R. Engineer and Superintendent, Department of Water, City of Newark, 128 Halsey Street, Newark, N. J.

1902. SHERWIN-WILLIAMS COMPANY, THE. Paint and Varnish Makers. E. C. Holton, Chemist-in-Chief, 100 Canal Street, Cleveland, O.

1899. *SHIMER, PORTER W. Chemist and Metallurgist, Easton, Pa.

1910. SHORE, ALBERT F. President, Shore Instrument Company, 557 West Twenty-second Street, New York, N. Y.

1906. SHULTS, CHARLES. Salesman, Worth Brothers Company, 111 Broadway, New York, N. Y.

1902. SHUMAN, JESSE J. Inspecting Engineer, Testing Department, Jones and Laughlin Steel Company, Pittsburg, Pa.

1904. SIMMONS, WILLIAM H. Superintendent, Badger Portland Cement Company, Sturgeon Bay, Wis.

1908. SIPE, JAMES B. President, James B. Sipe and Company, North Side, Pittsburg, Pa.

ELECTED.

1903. *SKINNER, C. E. Electrical Engineer, Westinghouse Electric and Manufacturing Company, East Pittsburg, Pa.

1908. SKINNER, HERVEY J. Vice-President, Arthur D. Little, Incorporated, 93 Broad Street, Boston, Mass.

1904. *SKINNER, ORVILLE CAMPBELL. Assistant Superintendent, Standard Steel Works, Burnham, Pa.

1910. SLOCUM, CHARLES V. Special Agent, The Titanium Alloy Manufacturing Company, 5500 Irwin Avenue, Pittsburg, Pa.

1908. SLOCUM, CURLYS LYON. Assistant Engineer, Pennsylvania Tunnel and Terminal Railroad Company, 10 Bridge Street, New York, N. Y.

1908. *SLOCUM, FRANK S. Metallurgist, Jones and Laughlin Steel Company, Pittsburg, Pa.

1910. SLOSS, JAMES C. Chemist, Alequippa, Pa.

1906. ‡SMART, L. A. Analyst for City Works Department, Old Waterworks, Winnipeg, Canada.

1907. SMITH, CHARLES E. Maintenance of Way Department, Missouri Pacific Railway Company, St. Louis, Mo.

1908. SMITH, C. M. Assistant Professor of Physics, Purdue University, 910 South Ninth Street, Lafayette, Ind.

1906. *SMITH, EMERY AND COMPANY. Chemists and Chemical Engineers, 651 Howard Street, San Francisco, Cal.

1906. *SMITH, E. B. In charge of Mechanical Laboratories, Drexel Institute, Thirty-second and Chestnut Streets, Philadelphia, Pa.

1907. SMITH, FRANCIS P. Chemical Engineer, 24–26 East Twenty-first Street, New York, N. Y.

1902. *SMITH, H. E. Chemist, The Lake Shore and Michigan Southern Railway Company, 36 Beersford Place, East Cleveland, O.

1910. ‡SMITH, H. LE H. Chief of Testing Bureau, Brooklyn Rapid Transit Company, Kent and Division Streets, Brooklyn, N. Y.

1905. SMITH, JAMES CRUICKSHANK. Chemical Engineer and Color Trade Expert, Holmdene, Colebrooke Avenue, West Ealing, W., England.

1908. SMITH, KERRY AND CHACE. Consulting and Constructing Engineers, 124-126 Confederation Life Building, Toronto, Canada.

ELECTED.

1910. SMITH, LAWRENCE SOUTHWICK. Instructor in Mechanical Engineering, Massachusetts Institute of Technology, Boston, Mass.

1909. ‡SMITH, STUART. Chief Chemist, Marquette Cement Manufacturing Company, La Salle, Ill.

1910. *SNELLING, WALTER O. Explosives Chemist, United States Geological Survey, Fortieth and Butler Streets, Pittsburg, Pa.

1904. SNODGRASS, A. E. Assistant Superintendent, Speed Mills, Louisville Cement Company, Sellersburg, Ind.

1902. *SNOW, J. P. Chief Engineer, Boston and Maine Railroad, Boston, Mass. *For Mail:* 58 Chandler Street, West Somerville, Mass.

1908. SOCIETY OF GAS ENGINEERING OF NEW YORK. W. Cullen Morris, 4 Irving Place, New York, N. Y.

1909. *SOMMER, ALBERT. Consulting Chemist, 17 Battery Place, New York, N. Y.

1904. SOMMERVILLE, C. W. Computer in charge of Tests, Building Department, Washington, D. C.

1903. *SOUTHER, HENRY. Consulting Metallurgical Engineer; State Chemist, 440 Capitol Avenue, Hartford, Conn.

1904. *SPACKMAN ENGINEERING COMPANY, HENRY S. 42 North Sixteenth Street, Philadelphia, Pa.

1905. SPALDING, F. P. Professor of Civil Engineering, University of Missouri, Columbia, Mo.

1902. SPANGLER, H. W. Professor of Mechanical Engineering, University of Pennsylvania, Philadelphia, Pa.

1905. *SPARE, C. R. Vice-President, American Manganese Bronze Company, Holmesburg, Philadelphia, Pa.

1906. SPARHAWK, GEORGE F. Engineer, American Bridge Company, Ambridge, Pa.

1910. *‡SPAULDING, RALPH E. Instructor in Civil Engineering, Worcester Polytechnic Institute, 210 West Street, Worcester, Mass.

1909. *SPENCER, HERBERT. Civil Engineer, 26 Broadway, New York, N. Y.

1909. *SPERRY, EDWIN S. Metallurgist, *The Brass World*, 260 John Street, Bridgeport, Conn.

1901. SPERRY, W. L. President and Manager, The Cumberland Hydraulic Cement and Manufacturing Company, Post Office Box 264, Cumberland, Md.

ELECTED.

1906. SPRAGUE, L. G. Chemist, Virginia Portland Cement Company, Fordwick, Va.

1908. SQUIRES, WILLIS C. Consulting Engineer, 209 Western Union Building, Chicago, Ill.

1908. STAFFORD, C. EDWARD. President, Tidewater Steel Company, Chester, Pa.

1909. *STAFFORD, SAMUEL G. Vice-President and General Manager, Vulcan Crucible Steel Company, Alequippa, Pa.

1908. STANDARD ASPHALT AND RUBBER COMPANY. W. L. Levering, Treasurer, 205 La Salle Street, Chicago, Ill.

1907. STANDARD INSPECTION BUREAU, LIMITED. T. C. Irving, Jr., Secretary-Treasurer, 1314 Traders' Bank Building, Toronto, Canada.

1902. *STANDARD STEEL WORKS. J. P. Sykes, Superintendent, Burnham, Pa.

1909. STANDARD UNDERGROUND CABLE COMPANY. C. C. Baldwin, Superintendent, Wire and Rod Mill, Perth Amboy, N. J.

1910. STANFORD UNIVERSITY, LELAND, JUNIOR. G. T. Clark, Librarian, Stanford University, Cal.

1905. STANGER, R. H. HARRY. Consulting Engineer, Testing Works and Chemical Laboratories, 2 Broadway, Westminster, London, S. W., England.

1907. *STANSFIELD, ALFRED. Professor of Metallurgy, McGill University, Montreal, Canada.

1903. STAPLETON, F. M. 715 Poplar Street, York, Pa.

1910. STARR, JOHN J. Secretary, The Robinson Clay Products Company, Akron, O.

1907. STATE GEOLOGICAL SURVEY. H. F. Bain, Director, Urbana, Ill.

1904. *STATTELMANN, G. R.. 37 West Washington Street, Dayton, O.

1910. STAVERT, W. D. Inspector of Works, Canadian Pacific Railway Company, 43 The New Sherbrooke, 670 Sherbrooke Street, West, Montreal, Canada.

1909. STEIN, C. H. Engineer, Maintenance of Way, Central Railroad of New Jersey, Jersey City, N. J.

1899. STEINMAN, A. J. Chairman, Pennsylvania Iron Company, Limited, Lancaster, Pa.

1896. *STEVENSON, A. A. Vice-President, Standard Steel Works Company, 1103 Harrison Building, Philadelphia, Pa.

ELECTED.

1908. STEVENSON, JOHN G. Inspector of Bridges, 249 Rochelle Avenue, Wissahickon, Philadelphia, Pa.

1909. STEWART, L. C. General Manager, Virginia Metal Culvert Company, Roanoke, Va.

1906. STILLMAN, HOWARD. Mechanical Engineer and Engineer of Tests, Southern Pacific Company, 2430 Piedmont Avenue, Berkeley, Cal.

1899. *STILLMAN, THOMAS B. Professor of Chemistry, Stevens Institute of Technology, Hoboken, N. J.

1909. STITT, HERBERT LEE. Inspector of Bridge Materials, Baltimore and Ohio Railroad, 1122 Locust Street, North Side, Pittsburg, Pa.

1909. STODDARD, RAYMOND FRENCH. Engineer, Congress Street Bridge Commission, Millford, Conn.

1907. STOEK, H. H. Editor, *Mines and Minerals*, Scranton, Pa.

1910. STONE, GEORGE C. Metallurgist, New Jersey Zinc Company, 55 Wall Street, New York, N. Y.

1903. STOREY, W. B., JR. Vice-President, Atchison, Topeka and Sante Fé Railroad Company, 1033 Railway Exchange Building, Chicago, Ill.

1906. STORRS, L. S. Vice-President, New England Investment and Security Company, Springfield, Mass.

1902. *STOUGHTON, BRADLEY. Metallurgist, 165 Broadway, New York, N. Y.

1910. STRACHAN, ROBERT C. Assistant Engineer, Department of Bridges, City of New York. *For Mail:* 371 Grant Avenue, Richmond Hill, N. Y.

1903. STRATTON, E. PLATT. 66–70 Beaver Street, New York, N. Y.

1907. STRATTON, S. W. Director, United States Bureau of Standards, Washington, D. C.

1909. *STRICKLER, G. B. Care of William B. Parsons, 60 Wall Street, New York, N. Y.

1896. STROBEL, CHARLES L. Consulting Engineer, 1744 Monadnock Block, Chicago, Ill.

1908. STRONG, ROBERT M. Care of Mallinckrodt Chemical Works, St. Louis, Mo.

1910. *STUDEBAKER LIBRARY. Studebaker Brothers Manufacturing Company, South Bend, Ind.

1904. *STUETZ, E. Vice-President and Treasurer, The Goldschmidt Thermit Company, 90 West Street, New York, N. Y.

1909. SUMNER, WARREN E. Chemist, Box 13, East Walpole, Mass.

ELECTED.

1906. SUYDAM, RICHARD S. President, M. B. Suydam Paint Company, Pittsburg, Pa.

1896. *SWAIN, GEORGE F. Professor of Civil Engineering, Graduate School of Applied Science, Harvard University, Pierce Hall, Oxford Street, Cambridge, Mass.

1903. SWANBERG, F. L. Secretary, The D. T. Williams Valve Company, 904–910 Broadway, Cincinnati, O.

1907. *SWENSON, P. M. Superintendent of Bridges and Buildings, Minneapolis, St. Paul and Sault Ste. Marie Railway Company, Shoreham Shops, Minneapolis, Minn.

1903. *SWENSSON, EMIL. Consulting Engineer, Frick Building, Pittsburg, Pa.

1908. SWITZER, JOHN A. Assistant Professor of Experimental Engineering, University of Tennessee, Knoxville, Tenn.

1905. *TABER, GEORGE H. General Manager, Gulf Refining Company, Frick Building, Pittsburg, Pa.

1903. TAGGART HOWARD. Engineer of Tests, Lukens Iron and Steel Company, Post Office Box 632, Coatesville, Pa.

1898. *TALBOT, ARTHUR N. Professor of Municipal and Sanitary Engineering, University of Illinois, Urbana, Ill.

1902. TALBOT, HENRY P. Professor of Inorganic and Analytical Chemistry, Massachusetts Institute of Technology, Boston, Mass.

1904. TASSIN, WIRT. With Duplex Metals Company, Chester, Pa.

1904. TAUBENHEIM, ULRICH E. Manager, City Water Works, Archangel, Russia.

1909. *‡TAYLOR, C. MARSHALL. Superintendent, Tie Treating Plant, Philadelphia and Reading Railway, Philadelphia, Pa.

1909. TAYLOR, EDWARD H. President, Commercial Testing and Engineering Company, 1785 Old Colony Building, Chicago, Ill.

1908. TAYLOR, JOHN. Manager, Union Sand and Material Company, Tiggett Building, St. Louis, Mo.

1908. TAYLOR, JOHN O. 311 Daniel Street, Champaign, Ill.

1906. *TAYLOR, KNOX. General Manager, Taylor Iron and Steel Company, High Bridge, N. J.

1900. TAYLOR, WILLIAM PURVES. Engineer in Charge, Testing Laboratory, 318 City Hall, Philadelphia, Pa.

ELECTED.

1896. *TECHNISCHER VEREIN, NEW YORK. Carl Kaelble, Secretary, Room 719, Engineering Building, 29 West Thirty-ninth Street, New York, N. Y.

1896. *TECHNISCHER VEREIN, PITTSBURG. Franz Denk, Secretary, 222 Craft Avenue, Pittsburg, Pa.

1910. *TESTING LABORATORY, CITY OF ST. LOUIS. Mont Schuyler, Engineer-in-Charge, Kingshighway and Eager Road, St. Louis, Mo.

1902. THACHER, EDWIN. Consulting Engineer; Member, Concrete-Steel Engineering Company, Park Row Building, New York, N. Y.

1907. ‡THELEN, ROLF. Engineer of Timber Tests, Forest Service, Washington, D. C.

1900. *THOMAS, DAVID. Logan Iron and Steel Company, Burnham, Pa.

1908. THOMAS, GEORGE, 3D. Treasurer, Parkesburg Iron Company, Parkesburg, Pa.

1906. ‡THOMPSON, G. SAXTON. Assistant in Mechanics, Rensselaer Polytechnic Institute, 861 Second Avenue, Upper Troy, Troy, N. Y.

1903. *THOMPSON, GUSTAVE W. Chemist, National Lead Company, 129 York Street, Brooklyn, N. Y.

1905. *THOMPSON, HUGH L. Consulting Engineer, Waterbury, Conn.

1907. *THOMPSON, JOHN FAIRFIELD. Chief of Testing Department, The Orford Copper Company, New Brighton, Staten Island, N. Y.

1904. *THOMPSON, SANFORD E. Civil Engineer, Newton Highlands, Mass.

1904. THOMSON, FRANK K. Barrett and Thomson, Post Office Box 574, Raleigh, N. C.

1908. THOMSON, REGINALD H. City Engineer, 701 Yetler Way, Seattle, Wash.

1908. ‡TIBBETTS, FRED W. Instructor in Civil Engineering, University of California, Berkeley, Cal.

1909. TIEMANN, HARRY D. 1714 Q Street, N. W., Washington, D. C.

1910. *TIEMANN, HUGH P. Metallurgist, Carnegie Steel Company, Pittsburg, Pa.

1908. TILT, EDWIN B. Engineer of Tests, Canadian Pacific Railway, 4278 Western Avenue, Westmount, Canada.

ELECTED.

1909. TINKER, GEORGE H. Bridge Engineer, New York, Cincinnati and St. Louis Railway, 420 Hickok Building, Cleveland, O.

1908. ‡TISSING, DAVID. Assistant Chemist, Northern Pacific Railway Company, General Office Building, St. Paul, Minn.

1903. *TOCH, MAXIMILIAN. Paint Manufacturer, 320 Fifth Avenue, New York, N. Y.

1903. TOMKINS, CALVIN. Manufacturer, Whitehall Building, 17 Battery Place, New York, N. Y.

1903. TOUCEDA, ENRIQUE. Chemist and Metallurgist, 51 State Street, Albany, N. Y.

1908. TOULMIN, PRIESTLEY. President, Lehigh Coal Company, Lehigh, Ala.

1906. TRAUTWEIN, A. P. President, Carbondale Instrument Company, Carbondale, Pa.

1907. *TRAUTWINE, JOHN C., JR. Civil Engineer, 257 South Fourth Street, Philadelphia, Pa.

1906. TRETCH, WILLIAM J. Superintendent, Riehlé Brothers Testing Machine Company, 1424 North Ninth Street, Philadelphia, Pa.

1905. *TRIST, N. B. With Carnegie Steel Company, Fifth Avenue, Pittsburg, Pa.

1904. TROOIEN, O. N. Mechanical Engineer, 339 Hellger Avenue, Detroit, Mich.

1908. *TUCKER, HERMAN FRANKLIN. Designing Engineer, Culebra, Canal Zone.

1904. TUFTS COLLEGE, DEPARTMENT OF ENGINEERING. Gardner C. Anthony, Dean, Tufts College, Mass.

1909. *TULANE UNIVERSITY, DEPARTMENT OF EXPERIMENTAL ENGINEERING. Professor W. B. Gregory, New Orleans, La.

1902. *TURNEAURE, F. E. Dean of the College of Mechanics and Engineering, University of Wisconsin, Madison, Wis.

1906. *TURNER, HENRY C. President, Turner Construction Company, 11 Broadway, New York, N. Y.

1908. UMSTADTER, J. M. Manager, Norfolk Office, M. J. Drummond and Company, Norfolk, Va.

1909. *UNGER, J. S. Manager, Central Research Laboratory, Carnegie Steel Company, Duquesne, Pa.

1908. *UNION DRAWN STEEL COMPANY. F. N. Beegle, President, Beaver Falls, Pa.

ELECTED.

1907. UNION STEEL CASTING COMPANY. C. C. Smith, President, Sixty-first and Butler Streets, Pittsburg, Pa.

1908. UNITED GAS IMPROVEMENT COMPANY. W. H. Gartley, Engineer of Works (Philadelphia Gas Works), Twenty-third and Filbert Streets, Philadelphia, Pa.

1909. UNITED PAVING COMPANY. W. I. Cherry, President and General Manager, 537 Bartlett Building, Atlantic City, N. J.

1908. UNITED STATES CAST IRON PIPE AND FOUNDRY COMPANY. William B. Franklin, Manager, Philadelphia Branch, 1231 Land Title Building, Philadelphia, Pa.

1907. *UNITED STATES GUTTA PERCHA PAINT COMPANY. Herbert W. Rice, Secretary, Providence, R. I.

1906. UNIVERSITY OF KANSAS, SCHOOL OF ENGINEERING. F. O. Martin, Dean, Lawrence, Kan.

1910. UNIVERSITY OF NORTH DAKOTA. Charles H. Compton, Library, University, N. D.

1910. UNIVERSITY OF PITTSBURG. Miss Katherine Elston, Librarian, Grant Boulevard, Pittsburg, Pa.

1906. VANDEVORT, F. F. Iron and Steel Agent, 66 Broadway, New York, N. Y.

1903. VAN GUNDY, C. P. Chief Chemist, Baltimore and Ohio Railroad, Mont Clare, Baltimore, Md.

1902. *VAN ORNUM, J. L. Professor of Civil Engineering, Washington University, St. Louis, Mo.

1908. VAN PELT, SUTTON. Manager of Construction, The American Asphaltum and Rubber Company, 601 Harvester Building, Chicago, Ill.

1909. ‡VAN TRUMP, ISAAC. Chief Chemist, The American Asphalt Paving Company, 2337 South Paulina Street, Chicago, Ill.

1908. ‡VAUCLAIN, JACQUES L. Engineer of Tests, Baldwin Locomotive Works, 500 North Broad Street, Philadelphia, Pa.

1908. VEITCH, F. Chief Chemist, Leather and Paper Laboratory, Bureau of Chemistry, Department of Agriculture, Washington, D. C.

1909. VIAL, F. K. Construction Engineer, Griffin Wheel Company, Sacramento Square, Chicago, Ill.

1909. *VIELE, BLACKWELL AND BUCK. Consulting Engineers, 49 Wall Street, New York, N. Y.

ELECTED.

1896. VOGT, A. S. Mechanical Engineer, Pennsylvania Railroad, Altoona, Pa.

1907. VOIGHT, M. L. Superintendent of Shops, Borden's Condensed Milk Company, 952 De Kalb Avenue, Brooklyn, N. Y.

1903. *VON SCHRENK, HERMANN. Von Schrenk, Fulks and Kammerer, Consulting Timber Engineers, Tower Grove and Fled Avenue, St. Louis, Mo.

1902. *VOORHEES, S. S. Engineer of Tests, Technologic Branch, United States Geological Survey, Washington, D. C.

1903. *VREDENBURGH, WATSON, JR. Member, Hildreth and Company, Engineers, 135 Broadway, New York, N. Y.

1904. *WACHTER, CHARLES LUCAS. Assistant Engineer, Lidgerwood Manufacturing Company, 96 Liberty Street, New York, N. Y.

1909. WACLARK WIRE COMPANY. F. W. Wallace, Treasurer, 49 Wall Street, New York, N. Y.

1896. *WADDELL, J. A. L. Consulting Civil Engineer, 1012 Baltimore Avenue, Kansas City, Mo.

1908. WADLEIGH, F. R. Assistant General Manager, Castner, Curran and Bullitt, 165 Broadway, New York, N. Y.

1907. WADSWORTH, J. E. Resident Engineer, American Bridge Company, Hudson Terminal, 30 Church Street, New York, N. Y.

1904. WAGENHORST, JAMES H. Westinghouse Machine Company, Pittsburg, Pa.

1899. *WAGNER, SAMUEL TOBIAS. Assistant Engineer, Philadelphia and Reading Railway, Huntingdon Street Station, Philadelphia, Pa.

1903. WAID, D. EVERETT. Architect, 156 Fifth Avenue, New York, N. Y.

1904. WALDO BROTHERS. 102 Milk Street, Boston, Mass.

1910. *WALDO, LEONARD. Consulting Engineer, 49 Wall Street, New York, N. Y.

1910. WALKER, H. F. Chief Chemist, Standard Steel Works Company, Box 598, Burnham, Pa.

1902. *WALKER, JOSEPH F. With Patton Paint Company, Newark, N. J. *For Mail:* 1431 Powell Street, Norristown, Pa.

1907. WALKER, PERCY H. Chief Chemist, Contracts Laboratory, Bureau of Chemistry, Washington, D. C.

ELECTED.

1905. *WALKER, WILLIAM H. Professor of Industrial Chemistry, Massachusetts Institute of Technology, 24 Trinity Place, Boston, Mass.

1910. *WALKER, W. R. Assistant to President, United States Steel Corporation, 71 Broadway, New York, N. Y.

1904. *WALLACE, E. C. 306 South Street, Jamaica Plains, Mass.

1910. WALLACE, JOHN T. Vice-President, Blackmer and Post Pipe Company, 613 Wainwright Building, St. Louis, Mo.

1903. *WALTER, LEE W. Cement Inspector, Erie Railroad, Ninth and Provost Streets, Jersey City, N. J.

1908. WALTERS, HARRY E. Metallurgical Chemist, Lincoln Foundry Company, Sixtieth and Butler Streets, Pittsburg, Pa.

1905. WARD, C. E. With Pittsburg Coal Company, Box 2, Castle Shannon, Pa.

1904. WARDELL, H. R. General Sales Agent, Barber Asphalt Paving Company, Philadelphia, Pa.

1903. WARNER, GEORGE C. Sullivan Machinery Company, Post Office Box 33, Claremont, N. H.

1905. WARREN BROTHERS COMPANY. 93 Federal Street, Boston, Mass.

1908. ‡WARTMAN, ARTHUR H. Engineer of Tests, Pencoyd Iron Works, Pencoyd, Pa.

1907. WASHBURN, FRANK E. Resident Engineer, St. Louis Electric Bridge Company, Salisbury and Hall Streets, St. Louis, Mo.

1906. WASHINGTON UNIVERSITY. C. M. Woodward, Dean of School of Engineering and Architecture, St. Louis, Mo.

1904. WASON, LEONARD C. President, Aberthaw Construction Company, 8 Beacon Street, Boston, Mass.

1904. WEBB, Z. Chief Chemist, Eliza Furnace, Jones and Laughlin Steel Company. *For Mail:* 861 Lilac Street, Pittsburg, Pa.

1900. *WEBSTER, GEORGE S. Chief Engineer and Surveyor, Bureau of Surveys, 318 City Hall, Philadelphia, Pa.

1898. *WEBSTER, WILLIAM R. (*Member of Executive Committee*). Civil Engineer, 411 Walnut Street, Philadelphia, Pa.

1909. *WEBSTER, WILLIAM R. General Superintendent, Bridgeport Brass Company, Bridgeport, Conn.

1906. WEEKS, PAUL. Needles, Cal.

1906. *‡WELD, HAROLD KENNETH. Sales Department, McRoy Clay Works, The Rookery, Chicago, Ill.

ELECTED.

1904. WENTWORTH, CHARLES C. Principal Assistant Engineer, Norfolk and Western Railway, Roanoke, Va.

1905. WENTZ, DANIEL B. President, Stonega Coal and Coke Company, 1723 Land Title Building, Philadelphia, Pa.

1897. WEST, THOMAS D. Foundry Expert, The West Steel Casting Company, 805 East Seventieth Street, Cleveland, O.

1909. WESTERN ELECTRIC COMPANY. G. Crossman, in charge of Inspection Branch, Engineering Department, 463 West Street, New York, N. Y.

1908. WESTINGHOUSE, CHURCH, KERR AND COMPANY. C. M. Chapman, Engineer-in-Charge, 10 Bridge Street, New York, N. Y.

1904. WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY. L. A. Osborne, Vice-President, Post Office Box 911, Pittsburg, Pa.

1907. WESTON, FREDERICK W. Standard Steel Works, 1982 Hudson Terminal Building, New York, N. Y.

1908. WEST VIRGINIA UNIVERSITY LIBRARY. Nathaniel L. Goodrich, Librarian, Morgantown, W. Va.

1910. WETHERILL, C. T. President, G. D. Wetherill and Company, 114 North Front Street, Philadelphia, Pa.

1906. WETTACH, CHARLES D. Secretary, W. W. Lawrence and Company, West Carson Street, Pittsburg, Pa.

1907. ‡WEYMOUTH, FREDERICK A. Special Metallurgist, Maryland Steel Company, Sparrows Point, Md.

1906. WHEELER, EDWARD J. Consulting Chemist, 79 Chapel Street, Albany, N. Y.

1905. WHINERY, S. Consulting Engineer on Pavements, Borough of Manhattan, 95 Liberty Street, New York, N. Y.

1908. WHIPPLE, GEORGE C. Consulting Engineer, 103 Park Avenue, New York, N. Y.

1909. WHITE, ALFRED H. Junior Professor of Chemical Engineering, University of Michigan, 933 Forrest Avenue, Ann Arbor, Mich.

1906. *WHITE, G. D. Manager, Patton Paint Company, Newark, N. J.

1909. WHITE AND COMPANY, J. G. C. D. Gray, Assistant Electrical Engineer, 43 Exchange Place, New York, N. Y.

1909. *‡WHITEHEAD, ALLEN O. Assistant Manager, The Whitehead Iron and Steel Company, Tredegar, Monmouthshire, England.

ELECTED.

1902. WHITNEY, WILLIS R. Research Laboratory, General Electric Company, Schenectady, N. Y.

1898. *WICKHORST, MAX H. Engineer of Tests, Rail Committee, American Railway Engineering and Maintenance of Way Association, 962 Monadnock Block, Chicago, Ill.

1908. WIDDICOMBE, R. A. Engineer, 2573 Lakewood Avenue, Edgewater Station, Chicago, Ill.

1906. WIELAND, CHARLES F. Consulting Engineer, 911 Mutual Saving Bank Building, San Francisco, Cal.

1909. ‡WIG, RUDOLPH J. Assistant Engineer, United States Geological Survey, Young's Ocean Pier, Atlantic City, N. J.

1909. ‡WIGHT, FRANK C. Associate Editor, *Engineering News*, 220 Broadway, New York, N. Y.

1910. WILCOX, CARL G. Foreman, Machine Shop, Michigan Agriculture College, P. O. Box 158, East Lansing, Mich.

1910. WILEY, W. O. Secretary, John Wiley and Sons, 43 East Nineteenth Street, New York, N. Y.

1902. WILHELM COMPANY, THE A. Paint Makers. Walter S. Davis, Secretary and Treasurer, Reading, Pa.

1910. WILKINS, O. P. Master Painter, Norfolk and Western Railway, Roanoke, Va.

1898. WILLE, H. V. Assistant to Superintendent, Baldwin Locomotive Works, 500 North Broad Street, Philadelphia, Pa.

1908. ‡WILLIAMS, C. C. Instructor in Civil Engineering, University of Colorado, 1313 Seventh Street, Boulder, Colo.

1908. WILLIAMS, HENRY J. Chemical Engineer, 161 Tremont Street, Boston, Mass.

1905. WILLIAMSON, SYDNEY B. Consulting Engineer, Culebra, Canal Zone.

1906. WILSON, EDWARD F. Chemist, Westmoreland Coal Company, Irwin, Pa.

1908. WILSON, PERCY H. Secretary, Association of American Portland Cement Manufacturers, 1232 Land Title Building, Philadelphia, Pa.

1906. *WINCHESTER REPEATING ARMS COMPANY. R. L. Penney, in charge of Physical Laboratory, New Haven, Conn.

1909. WINDER, JOHN H. President, Clinchfield Coal Corporation, Roanoke, Va.

1900. *WING, CHARLES B. Professor of Structural Engineering, Leland Stanford Junior University, Cal.

ELECTED.

1909. *‡WINT, RUFUS W. G. Chemist, care of Firth-Sterling Steel Company, P. O. Box 812, Washington, D. C.

1907. ‡WITHEY, MORTON OWEN. Assistant Professor of Mechanics, University of Wisconsin. *For Mail:* 1630 Madison Street, Madison, Wis.

1903. WITTMAN, N. B. Potts and Wittman, North American Building, Philadelphia, Pa.

1906. WOLF, OTTO C. Engineer and Architect, 511 Denckla Building, Philadelphia, Pa.

1903. *WOLFEL, PAUL L. Chief Engineer, McClintic-Marshall Construction Company, Rankin, Pa.

1908. WOLFF, M. A. Mining Engineer, care of Institution of Mining and Metallurgy, Salisbury House, E. C., London, England.

1908. WOOD, ALAN, 3D. Mechanical Engineer, Conshohocken, Pa.

1903. WOOD, EDWARD R., JR. Manufacturer, 400 Chestnut Street, Philadelphia, Pa.

1910. ‡WOOD, EDWIN T. Engineer of Tests, La Belle Iron Works, Steubenville, O.

1903. WOOD, F. W. President, Maryland Steel Company, Sparrows Point, Md.

1902. *WOOD AND COMPANY, R. D. Founders. Walter Wood, 400 Chestnut Street, Philadelphia, Pa.

1900. *WOOD, WALTER. Cast-Iron Pipe Manufacturer, R. D. Wood and Company, 400 Chestnut Street, Philadelphia, Pa.

1910. WOODROFFE, G. H. Assistant Engineer of Tests, Baldwin Locomotive Works, 1 West Johnson Street, Germantown, Philadelphia, Pa.

1906. WOODS, R. M. Chief Chemist, Northern Pacific Railway Company, General Office Building, St. Paul, Minn.

1906. WOODWELL, JULIAN E. Consulting Engineer, Terminal Building, Park Avenue and Forty-first Street, New York, N. Y.

1908. WOODWORTH, R. B. Engineer with Carnegie Steel Company, 427 Carnegie Building, Pittsburg, Pa.

1900. *WOOLSON, IRA H. Consulting Engineer, National Board of Fire Underwriters, 135 Williams Street, New York, N. Y.

1904. *WORCESTER, JOSEPH R. J. R. Worcester and Company, 79 Milk Street, Boston, Mass.

ELECTED.

1905. WORCESTER POLYTECHNIC INSTITUTE. William W. Bird, Director of the Department of Mechanical Engineering, Worcester, Mass.

1904. WORMELEY, P. L., JR. Engineer of Tests, Division of Tests, United States Department of Agriculture, Washington, D. C.

1909. WULFETUNGE, J. F. Purchasing Agent, Riter-Conley Manufacturing Company, Pittsburg, Pa.

1910. WYER, M. G. Librarian, State University of Iowa, Iowa City, Iowa.

1906. *WYMAN AND GORDON COMPANY, THE. George F. Fuller, General Superintendent and Secretary, Worcester, Mass.

1909. *YAMAGUCHI, JUNNOSUKE. Director, Imperial Japanese Railways, Shimbashi, Tokio, Japan.

1907. YOUNG, J. BERTRAM. Chemist, Philadelphia and Reading Railway Company, Reading, Pa.

1908. YOUNG, JOHN M. Dean of Engineering, University of Hawaii, Honolulu, H. I.

1905. YOUNG, JOHN P. General Manager, Youngstown Car Manufacturing Company, Youngstown, O.

1908. *†YOUNG, W. W. Consulting Engineer, 220 Broadway, New York, N. Y.

1903. ZEHNDER, C. H. President, Alleghany Ore and Iron Company, 140 Cedar Street, New York, N. Y.

1908. *ZUERCHER, MAX A. Assistant Engineer, in charge of Rail, Switch and Frog Work, Canadian Pacific Railway, Bordeaux, Canada.

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## SUMMARY.

| | |
|---|---|
| Total Membership | 1,270 |
| Total number holding membership also in the International Association for Testing Materials | 420 |
| Number of Life Members | 2 |
| Number of Junior Members | 93 |

# DECEASED MEMBERS.

| Name. | Date of Membership. | Date of Death. |
|---|---|---|
| ALLIEN, VICTOR S. | 1906 | February 1, 1908. |
| ANDERSON, J. W. | 1896 | May 18, 1905. |
| ATKINSON, EDWARD | 1903 | December 11, 1905. |
| AUSTEN, P. T. | 1906 | December 30, 1907. |
| BALDWIN, S. W. | 1904 | January 5, 1910. |
| BARNSLEY G. T. | 1904 | October 23, 1909. |
| BLACK, W. P. | 1896 | December 12, 1902. |
| BUDD, HENRY I. | 1903 | January 14, 1905. |
| DROWN, THOMAS M. | 1899 | November 16, 1904. |
| DUDLEY, CHARLES B. | 1896 | December 21, 1909. |
| FRANKEL, HENRY U. | 1903 | December 8, 1903. |
| GOWEN, CHARLES S. | 1904 | October, 19, 1909. |
| GRAY, THOMAS | 1896 | February 12, 1909. |
| HOOPER, A. | 1908 | December 28, 1909. |
| JARECKI, CHARLES | 1896 | January 26, 1901. |
| JOHNSON, EDMUND | 1905 | May 23, 1909. |
| JOHNSON, J. B. | 1899 | June 23, 1902. |
| JOHNSON, W. C. | 1900 | December 15, 1906. |
| LUDLOW, S. H. | 1904 | January 16, 1908. |
| MCCAULEY, G. M. | 1898 | May 25, 1901. |
| METCALF, WILLIAM | 1903 | December 5, 1909. |
| MORISON, GEORGE S. | 1896 | July 1, 1903. |
| MORTON, HENRY | 1896 | May 9, 1902. |
| PIERCE, D. H. | 1907 | July 1, 1909. |
| TATNALL, GEORGE | 1906 | September 13, 1906. |
| THURSTON, ROBERT H. | 1896 | October 25, 1903. |
| WARMAN, F. C. | 1905 | April 27, 1908. |
| WOODMAN, D. | 1903 | September 4, 1907. |
| WRIGHT, H. H. | 1904 | June 22, 1905. |
| WYMAN, W. H. | 1905 | November 11, 1905. |

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## KANSAS.

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**Lawrence:** C. I. Corp; F. O. Marvin; H. A. Rice; University of Kansas, School of Engineering.

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## KENTUCKY.

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**Security:** C. M. Goodman.

**Sparrows Point:** H. C. Lane; S. S. Martin; F. A. Weymouth; F. W. Wood.

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**Southbridge:** C. H. Kerr.

**South Yarmouth:** C. H. Davis.

**Springfield:** The Emerson Laboratory; L. S. Storrs.

**Tufts College:** Tufts College, Department of Engineering.

**West Lynn:** General Electric Company, Lynn Works.

**MASSACHUSETTS.**—*Continued.*

**West Somerville:** J. P. Snow.

**Worcester:** American Steel and Wire Company; J. W. Bishop Company; E. L. Hancock; G. S. McFarland; Morgan Construction Company; S. M. Rodgers; R. E. Spaulding; Worcester Polytechnic Institute; The Wyman and Gordon Company.

**MICHIGAN.**

**Agricultural College:** J. A. Polson.

**Ann Arbor:** A. H. White.

**Detroit:** Berry Brothers, Limited; D. M. Ferguson; W. W. Maclay; A. W. Munsell; A. F. Neal; C. S. Neal; R. A. Plumb; W. H. Sellew; O. N. Trooien.

**East Lansing:** G. W. Bissell; C. G. Wilcox.

**Hubbell:** J. B. Cooper; G. L. Heath.

**Sault Ste. Marie:** L. C. Sabin.

**Union City:** A. Lundteigen.

**MINNESOTA.**

**Duluth:** E. K. Coe; F. Cramer.

**Minneapolis:** F. C. Bestor; W. H. Cavanaugh; P. M. Swenson.

**St. Paul:** D. Tissing; R. M. Woods.

**MISSISSIPPI.**

**University:** A. M. Muckenfuss.

**MISSOURI.**

**Columbia:** A. L. Hyde; F. P. Spalding.

**Independence:** J. L. Mack.

**Joplin:** L. S. Hughes.

**Kansas City:** I. H. Fetty; R. A. Long; B. Lowther; J. A. L. Waddell.

**Rolla:** E. R. Buckley.

**St. Louis:** W. M. Armstrong; E. H. Dyer; B. Enright; O. L. Garrison; N. B. Gregg; J. F. Hinckley; C. D. Holley; H. N. Hudson; A. L. Johnson; S. S. Knight; A. E. Lindau; H. W. Lohmann; N. R. McLure; Missouri Pacific Railway Company; C. D. Purdon; F. S. Rice; E. J. Russell; G. D. Scott; C. D. Smith; J. Taylor; City of St. Louis Testing Laboratory; R. M. Strong; J. L. Van Ornum; H. von Schrenk; J. T. Wallace; F. E. Washburn; Washington University.

**MONTANA.**

**Anaconda:** Anaconda Copper Mining Company.

**Bozeman:** Montana College of Agriculture and Mechanic Arts.

**Miles City:** J. J. Harding.

## NEBRASKA.

**Omaha:** D. O. Clark; W. F. Harriman; J. Hoffhine.
**South Omaha:** W. H. Low.

## NEW HAMPSHIRE.

**Clairmont:** G. C. Warner.

## NEW JERSEY.

**Alpha:** A. F. Gerstell.
**Atlantic City:** United Paving Company; R. J. Wig.
**Bayonne:** C. V. Bacon; J. L. Gray; T. T. Gray.
**Boonton:** R. W. Seabury.
**Bound Brook:** H. Abraham.
**Burlington:** W. R. Conard; J. A. Hayes.
**Elizabeth:** L. Addicks.
**Gibbsboro:** J. Lucas and Company.
**High Bridge:** J. H. Hall; J. J. Kerns; J. M. Sherrerd; K. Taylor.
**Hoboken:** T. J. Bateman; F. L. Pryor; T. B. Stillman.
**Jersey City:** W. J. Corliss; Joseph Dixon Crucible Company; J. Motion; J. A. Munsell; A. H. Sawyer; C. H. Stein; L. W. Walter.
**Mahwah:** F. W. Sargent.
**Maurer:** C. N. Forrest.
**Montclair:** J. H. Gregory; W. Kent; C. A. Mead.
**Newark:** B. L. Chandler; E. A. Condit; W. N. Hazen; W. Marshall; J. Owen; M. R. Sherrerd; G. D. White.
**Perth Amboy:** F. L. Antisell; J. C. Rossi; Standard Underground Cable Company.
**Phillipsburg:** W. R. Dunn.
**Plainfield:** F. Conlin; H. D. Hibbard.
**Ridgefield Park:** C. de Wyrall.
**Stewartsville:** H. E. Kiefer.
**Trenton:** H. C. Boynton; J. A. Roebling's Sons Company.
**Watchung:** American Foundrymen's Association; R. Moldenke.

## NEW YORK.

**Albany:** W. R. Davis; L. H. Dumary; R. S. Greenman; F. W. Kelley; J. E. Myers; G. P. Robinson; E. Touceda; E. J. Wheeler.
**Bedford Hills:** H. M. Howe.
**Brooklyn:** C. W. Aiken; R. W. Bailey; W. H. Broadhurst; W. H. Chater; E. J. Fort; G. T. Hammond; A. Helwig; F. P. Ingalls; G. Kaufman; J. W. Masury and Son; J. P. Millwood; A. Rogers; H. Le H. Smith; G. W. Thompson; M. L. Voight.
**Buffalo:** The Beaver Company; W. M. Corse; H. C Gibson; Lackawanna Steel Company; G. H. Pickard; F. W. Robinson; A. Schwarcman.
**Elmira:** R. T. Lewis.
**Flushing:** A. H. Sabin.

**NEW YORK.**—*Continued.*

**Glens Falls:** International Paper Company.
**Hastings-upon-Hudson:** G. P. Hemstreet.
**Hoosick Falls:** J. A. Beckett.
**Ilion:** Remington Arms Company.
**Ithaca:** R. C. Carpenter; Cornell University Library; R. P. Davis.
**Jamaica:** O. Erlandsen.
**Laurel Hill:** J. B. Herreshoff, Jr.
**New Brighton:** J. F. Thompson.
**Newburgh:** E. Penny.

**New York:** H. W. Adams; J. K. Adams; G. Aertsen; E. J. Alferis; A. Allen, Jr.; American Bureau of Shipping; American Railway Association; American Telephone and Telegraph Company; F. M. Andrews and Company; E. B. Ashby; F. T. H. Bacon; H. C. Baird; W. E. Baker and Company; Barrett Manufacturing Company; B. Berger; A. Black; J. C. Blanch; C. P. Bliss; Boller and Hodge; A. L. Bowman; O. Brainard; L. F. Braine; R. S. Buck; F. A. Burdett; W. H. Burr; W. Campbell; Carbon Steel Company; A. Carnegie; A. W. Carpenter; F. P. Cheesman; W. F. Chen; M. E. Chester; S. R. Church; A. Churchward; E. A. S. Clarke; E. B. Cobb; T. I. Coe; E. L. Corthell; J. A. Church; C. Davis; J. F. Deemes; E. W. DeKnight; Detroit Graphite Company; F. W. Devoe and C. T. Raynolds Company; L. C. Dilks; J. Douglass; W. J. Doing; Tsn . W. Dow; J. S. Doyle; P. H. Dudley; B. W. Dunn; H. Dunn;ugsla.ADwight; J. O. Eckersley; O. M. Eidlitz; A. Eilers; Electrical Test ig Laboratories; A. H. Elliott; F. A. Elmquist; *Engineering Record;* S. M. Evans; W. W. Ewing; M. S. Falk; A. Falkenau; F. M. Farmer; A. I. Findley; H. S. Fleming; A. E. Forstall; J. W. Frank; J. B. French; A. I. Frye; W. B. Fuller; R. H. Gaines; M. Gay; J. Gayley; G. Gibbs; F. A. Goetze; E. P. Goodrich; W. S. Gould; A. B. Hager; S. Hamburger; E. S. Hand; W. W. Havens; E. L. Heidenreich; R. Hering; P. S. Hildreth; N. S. Hill, Jr.; H. B. Hodges; O. Hoff; J. L. Holst; A. C. Horn; O. E. Hovey; J. W. Howard; C. T. Hutchinson; *Insurance Engineering;* R. J. Jenks; R. E. Jennings; S. W. Jones; E. Jonson; H. Josias; J. L. Kemmerer; J. J. Kennedy; J. A. Kinkead; C. Kirchhoff; P. A. Kirchner; J. A. Knighton; H. A. La Chicotte; C. G. E. Larsson; J. H. Lidgerwood, Jr.; P. T. Lindhard; E. McL. Long; A. N. Lukens; J. S. Macgregor; W. Main; A. N. Mansfield; C. P Marsh; J. C. McGuire; P. C. McIlhiney; C. F. McKenna; E. D. Meier; C. Meriwether; M. Merriman; *The Metal Industry;* R. P. Miller; C. M. Mills; A. E. Mitchell; L. S. Moisseiff; G. E. Molleson; F. B. Morse; M. Moulton; M. Moulton, Jr.; A. Moyer; W. Mueser; New Jersey Zinc Company; New York Fire Insurance Exchange; Orford Copper Company; J. M. Peters; A. Polk; L. R. Pomeroy; A. J. Provost, Jr.; Raymond Concrete Pile Company; M. Raymond; T. E. Rhodes; C. Richardson; L. D. Rights; A. E. Roberts; D. E. Robinson; H. B. Rodman; W. B. Ruggles; R. R. Rust; F. E. Schmitt; H. J. Schnell; F. Schniewind; A. W. Schwartz; C. E. Scribner; H. B. Seaman; Semet-Solvay Company; J. A. Setze; A. F.

**NEW YORK.**—*Continued.*

Shore; C. Shults; C. L. Slocum; F. P. Smith; Society of Gas Engineering of New York; A. Sommer; H. Spencer; G. C. Stone; B. Stoughton; E. P. Stratton; G. B. Strickler; E. Stuetz; New York Technischer Verein; E. Thacher; M. Toch; C. Tomkins; H. C. Turner; F. F. Vandevort; Viele, Blackwell and Buck; W. Vredenburgh; C. L. Wachter; Waclark Wire Company; F. R. Wadleigh; J. E. Wadsworth; D. E. Waid; L. Waldo; W. R. Walker; Western Electric Company; Westinghouse, Church, Kerr and Company; F. W. Weston; S. Whinery; G. C. Whipple; J. G. White and Company; F. C. Wight; W. O. Wiley; J. E. Woodwell; I. H. Woolson; W. W. Young; C. H. Zehnder.

**Niagara Falls:** F. A. J. FitzGerald; A. H. Hooker; International Acheson Graphite Company.

**Perry:** R. W. How.

**Potsdam:** T. S. Clarkson Memorial School of Technology.

**Richmond Hill:** H. Leidel; R. C. Strachan.

**Rochester:** F. R. Baxter.

**Schenectady:** J. A. Capp; H. E. Diller; General Electric Company; S. V. Hunnings; Schenectady Varnish Company; W. R. Whitney.

**Smith Landing:** H. C. Cowan.

**Syracuse:** H. C. Allen; W. H. Blauvelt; L. N. Fenner; H. H. Franklin Manufacturing Company; W. E. Hopton; J. A. Mathews.

**Tarrytown:** I. E. Blumgardt.

**Troy:** T. R. Lawson; Ludlow Valve Manufacturing Company; J. W. Nugent; G. S. Thompson.

**Victor:** The Locke Insulator Manufacturing Company.

**West Albany:** R. W. Mahon.

**Yonkers:** A. R. Gormully.

**NORTH CAROLINA.**

**Canton:** L. C. Buck.

**Raleigh:** F. K. Thomson.

**Waynesville:** J. W. Seaver, Jr.

**NORTH DAKOTA.**

**University:** University of North Dakota.

**OHIO.**

**Akron:** W. C. Geer; J. J. Starr.

**Canton:** E. A. Langenbach.

**Cincinnati:** E. J. Banta; A. B. Chamberlin; Cincinnati Chapter, American Institute of Architects; Eagle White Lead Company; G. K. Elliott; Elzner and Anderson; Engineers' Club of Cincinnati; C. E. Gage; H. Schneider; F. L. Swanberg.

**Cleveland:** H. B. Anderson; A. O. Backert; The Brown Hoisting Machinery Company; Case School of Applied Science, Department of

**OHIO.**—*Continued.*

Civil Engineering; R. Cathcart; The Civil Engineers' Club of Cleveland; B. Crowell; H. F. Deverell; R. H. Fernald; E. W. Furst; D. Gaehr; F. A. Glidden; *The Iron Trade Review;* H. R. Kimmel; F. H. Neff; The Osborn Engineering Company; F. J. Peck and Company; C. Schmidt; The Sherwin-Williams Company; H. E. Smith; G. H. Tinker; T. D. West.

**Collinwood:** G. S. Chiles; T. F. Clay, Jr.; G. E. Doke.

**Columbus:** F. L. Allcott; H. M. Bush; E. Orton, Jr.

**Dayton:** F. O. Clements; A. Giesler; H. G. Kittredge; D. A. Kohr; The Lowe Brothers Company; The National Cash Register Company; The Platt Iron Works Company; G. R. Stattelmann.

**Elyria:** C. M. Campbell.

**Mansfield:** C. T. Bragg.

**Massillon:** H. A. Croxton.

**Middletown:** J. A. Aupperle; W. J. Beck; R. B. Carnahan, Jr.; G. H. Charls; S. R. Rectanus.

**Sandusky:** S. B. Newberry.

**Steubenville:** E. T. Wood.

**Toledo:** D. M. Luehrs.

**Youngstown:** E. T. McCleary; C. S. Robinson; J. P. Young.

**OKLAHOMA.**

**Dewey:** P. R. Chamberlain.

**OREGON.**

**Portland:** D. D. Clarke; C. F. Heiberg; J. B. C. Lockwood; W. R. Phillips.

**PENNSYLVANIA.**

**Alequippa:** J. C. Sloss; S. G. Stafford.

**Allegheny:** J. J. Kaylor.

**Allentown:** C. A. Matcham; E. B. McCready; R. K. Meade; H. A. Reninger; D. E. Ritter; C. M. Saeger.

**Altoona:** W. O. Dunbar; A. W. Gibbs; W. F. Kiesel; G. B. Koch; P. Kreuzpointner; J. Lloyd; H. K. McCauley; M. E. McDonnell; E. D. Nelson; F. N. Pease; S. C. Potts; H. M. Ramsay; A. S. Vogt.

**Ambridge:** J. J. Boyle; A. J. Christie; G. F. Sparhawk.

**Bala:** W. Jordan, Jr.

**Beaver:** W. F. Dunspaugh.

**Beaver Falls:** Union Drawn Steel Company.

**Burnham:** J. C. Sellers, Jr.; O. C. Skinner; Standard Steel Works; D. Thomas; H. F. Walker.

**Canonsburg:** G. C. Schade.

**Carbondale:** A. P. Trautwein.

**Castle Shannon:** C. E. Ward.

**Catasauqua:** J. W. Fuller; L. Peckitt; H. J. Seaman.

**PENNSYLVANIA.**—*Continued.*

**Cementon:** H. S. Conover.

**Chester:** A. M. Comey; D. L. Eynon; C. E. Stafford; W. Tassin.

**Clearfield:** Clearfield Clay Working Company.

**Coatesville:** Lukens Iron and Steel Company; H. Taggart.

**Columbia:** W. Jenkins, Jr.

**Conshohocken:** W. A. Cooper; J. R. Jones; A. Wood, 3d.

**Du Bois:** Buffalo, Rochester and Pittsburg Railway Company.

**Duquesne:** J. F. Lewis; J. S. Unger.

**East Lansdowne:** J. H. Lincoln.

**Easton:** B. F. Fackenthal, Jr.; F. Firmstone; A. T. Goldbeck; Lafayette College Library; J. M. Porter; P. W. Shimer.

**East Pittsburg:** W. A. Bole; T. D. Lynch; C. E. Skinner.

**Emporium:** A. C. Blum.

**Erie:** A. Jarecki.

**Franklin:** P. H. Conradson.

**Glenshaw:** F. L. Garlinghouse.

**Greensburg:** J. P. Donohoe; W. F. Elwood.

**Harrisburg:** Central Iron and Steel Company; J. W. Hunter; A. S. McCreath and Son; C. J. Pretsch.

**Homestead:** J. H. Grose.

**Irwin:** E. F. Wilson.

**Johnstown:** Cambria Steel Company; E. F. Kenney.

**Kittanning:** W. Gowie.

**Lancaster:** A. J. Steinman.

**Latrobe:** C. E. Corson.

**Lebanon:** American Iron and Steel Manufacturing Company; C. J. Gadd.

**Marcus Hook:** J. H. Pew.

**Masontown:** H. E. Elson.

**McKeesport:** D. M. Buck; E. T. Edwards; G. M. Goodspeed; J. M. Jeffers; J. A. McCulloch.

**Munhall:** J. L. de Bertodano; J. W. McGrady.

**Nazareth:** J. Brobston.

**Norristown:** A. H. Fox; J. F. Walker.

**Oakmont:** J. Jones.

**Palmerton:** G. Rigg.

**Parkesburg:** H. A. Beale; G. Thomas, 3d.

**Pencoyd:** A. P. Hume; C. Major; A. H. Wartman.

**Philadelphia:** H. C. Adams; W. A. Aiken; Ajax Metal Company; American Bridge Company; R. I. D. Ashbridge; Barber Asphalt Paving Company; H. C. Berry; J. Birkinbine; A. Bonzano; Booth, Garrett and Blair; S. B. Bowen; J. W. Bramwell; H. DeH. Bright; J. G. Brown; R. P. Brown; W. L. Brown; W. C. Bullitt; A. M. Burnap; G. Butler; H. H. Campbell; J. Christie; E. Clark; C. H. Clifton; J. A. Colby; H. C. Crawford; E. A. Custer; J. Dallas; G. C. Davies; Dodge and Day; W. C.

**PENNSYLVANIA.**—*Continued.*

DuComb, Jr.; T. N. Ely; J. T. Fennell; L. R. Ferguson; T. Fisher; S. G. Flagg, Jr.; Franklin Institute; W. H. Fulweiler; H. A. Gardner; Glasgow Iron Company; E. T. Greene; R. E. Griffith; H. L. Haldeman; W. H. Harding; H. J. Hartley; W. G. Hartranft; H. E. Hayward; W. W. Hearn; G. B. Heckel; R. W. Hilles; Hughes and Patterson; R. L. Humphrey; R. K. Johnson; F. G. Kennedy, Jr.; L. H. Kenney; W. C. Kent; R. W. Lesley; J. B. Lober; A. Lovell; E. Marburg; Midvale Steel Company; J. S. Miller, Jr.; R. Mitchell; D. A. Morris; T. Olsen; A. E. Outerbridge, Jr.; W. M. Page; A. M. Parkes; Pennsylvania Crusher Company; R. S. Perry; M. M. Price; H. H. Quimby; J. T. Richards; W. B. Riegner; F. A. Riehlé; C. D. Rinald; J. Royal; C. C. Schneider; W. T. Sears; W. Sellers and Company, Incorporated; E. B. Smith; H. S. Spackman Engineering Company; H. W. Spangler; C. R. Spare; A. A. Stevenson; J. G. Stevenson; C. M. Taylor; W. P. Taylor; J. C. Trautwine, Jr.; W. J. Tretch; United Gas Improvement Company; United States Cast Iron Pipe and Foundry Company; J. L. Vauclain; S. T. Wagner; H. R. Wardell; G. S. Webster; W. R. Webster; D. B. Wentz; C. T. Wetherill; H. V. Wille; P. H. Wilson; N. B. Wittman; O. C. Wolf; E. R. Wood, Jr.; R. D. Wood and Company; W. Wood; G. H. Woodroffe.

**Phœnixville:** J. S. Deans.

**Pittsburg:** J. D. Ackenheil; I. C. Allen; American Waterworks and Guarantee Company; J. A. Atwood; P. H. Bates; A. W. Belden; A. V. Bleininger; W. A. Bostwick; Brown and Company, Incorporated; Carnegie Library; Carnegie Steel Company; Columbia Steel and Shafting Company; D. F. Crawford; A. E. Crockett; R. A. Cummings; W. C. Cushing; J. Dewar; J. A. Dubbs; Engineers' Society of Western Pennsylvania; M. S. Evans; H. W. Fisher; C. S. Foller; E. D. Frohman; H. F. Gilg; S. P. Grace; G. W. Greene; H. Gulick, Jr.; J. L. Haines; C. Hall; C. W. Heppinstall; T. E. Hewitt; M. Hokanson; C. W. Howard; S. B. Howell; E. T. Ickes; C. W. Johnson; Jones and Laughlin Steel Company; J. H. Jones; W. M. Kinney; E. S. Kniseley; M. Knowles; T. Lynch; F. M. Masters; J. B. Masters; A. M. McCrea; J. McLeod; D. W. McNaugher; D. H. Murphy; National Tube Company; G. L. Norris; J. E. Ober; J. N. Ostrom; J. E. Patton, Jr.; A. Pinkerton; Pittsburg Forge and Iron Company; Pittsburg Testing Laboratory; B. H. Rader; G. S. Rice; W. H. Rieger; G. N. Riley; J. C. Roberts; C. Rys; B. Saklatwalla; J. R. Sanborn; G. W. Sargent; G. W. Schluederberg; C. Shannon; J. J. Shuman; J. B. Sipe; C. V. Slocum; F. S. Slocum; W. O. Snelling; H. L. Stitt; R. S. Suydam; E. Swensson; G. H. Taber; Pittsburg Technischer Verein; H. P. Tiemann; N. B. Trist; Union Steel Casting Company; University of Pittsburg; J. H. Wagenhorst; H. E. Walters; Z. Webb; Westinghouse Electric and Manufacturing Company; C. D. Wettach; R. B. Woodworth; J. F. Wulfetunge.

**Pottstown:** E. S. Cook.

**Pottsville:** A. G. Blakeley; W. H. H. Ginder.

**Rankin:** P. L. Wolfel.

## PENNSYLVANIA.—*Continued.*

**Reading:** The Carpenter Steel Company; L. J. Heizmann; Reading Iron Company; The A. Wilhelm Company; J. B. Young.

**Scranton:** H. J. Force; J. M. Maris; H. H. Stoek.

**Sharon:** W. G. Kranz.

**South Bethlehem:** Bethlehem Steel Company; R. M. Bird; A. L. Colby; H. E. Cook; H. S. Drinker; F. P. McKibben; J. W. Richards; F. E. Schall.

**Steelton:** H. B. Bent; F. D. Carney; J. W. Dougherty; The Pennsylvania Steel Company; J. V. W. Reynders.

**Vandergrift:** A. H. Beale.

**Washington:** F. M. Sanger, Jr.

**West Pittsburg:** N. W. Buch.

**Wilkesbarre:** Hazard Manufacturing Company.

**Wilkinsburg:** R. H. Arnold; H. J. Lincoln.

**Wilmerding:** H. C. Loudenbeck.

**York:** C. H. Ehrenfeld; F. M. Stapleton.

## RHODE ISLAND.

**Phenix:** F. J. Hoxie.

**Providence:** A. H. Blanchard; Brown University, Department of Mechanical Engineering; H. B. Drowne; E. F. Ely; J. R. Freeman; A. J. Loepsinger; W. M. Saunders; United States Gutta Percha Paint Company.

## TENNESSEE.

**Knoxville:** J. A. Switzer.

**Nashville:** C. S. Brown; W. H. Schuerman.

**South Pittsburg:** W. H. Kewish.

## UTAH.

**Salt Lake City:** E. H. Beckstrand; M. M. Murtaugh.

## VIRGINIA.

**Alexandria:** J. C. Ramage.

**Bedford City:** E. D. Gregory.

**Blacksburg:** J. S. A. Johnson.

**Buell:** E. Christian.

**Fordwick:** L. G. Sprague.

**Norfolk:** J. M. Umstadter.

**Richmond:** F. B. Carpenter; Froehling and Robertson; H. S. Morrison; F. W. Scarborough.

**Roanoke:** C. S. Churchill; J. H. Gibboney; L. C. Stewart; C. C. Wentworth; O. P. Wilkins; J. H. Winder.

## WASHINGTON.

**Baker:** C. A. Newhall.

**Seattle:** Falkenburg and Laucks; A. H. Fuller; O. P. M. Goss; J. K. Moore; R. H. Thomson.

**Tacoma:** F. T. Crowe and Company; E. O. Heinrich.

## WEST VIRGINIA.

**Ansted:** W. H. Keller; W. N. Page.
**Fairmont:** F. R. Haas.
**Morgantown:** C. R. Jones; West Virginia University Library.

## WISCONSIN.

**Madison:** C. F. Burgess; M. Cline; E. R. Maurer; F. E. Turneaure; M. O. Withey.
**Mayville:** A. F. Plock.
**Milwaukee:** H. S. Falk; S. A. Greeley; F. S. Low; R. S. Mac Pherran; Milwaukee Electric Railway and Light Company; L. Patton; G. N. Prentiss.
**Sturgeon Bay:** W. W. Simmons.

## WYOMING.

**Laramie:** J. C. Fitterer.

## AUSTRALIA.

**Melbourne:** H. Payne.
**Sydney:** A. Scheidel.

## CANADA.

**Blacks Bridge:** R. H. Lordly.
**Bordeaux:** M. A. Zurcher.
**Dunnville:** W. F. Scott.
**Grand Mere:** A. W. Harris; Standard Inspection Bureau, Limited.
**Guelph:** H. B. Sharman.
**Marlbank:** P. F. Belfour.
**Montreal:** W. F. Angus; E. Brown; J. A. DeCew; Dominion Bridge Company; The Duckworth-Boyer Engineering and Inspection Company, Limited; G. Giroux; T. S. Griffiths; M. L. Hersey; R. Job; H. O. Keay; H. M. Mackay; S. D. MacNab; McGill University, Faculty of Applied Science; A. Stansfield; W. D. Stavert.
**Ottawa:** G. E. Perley.
**Toronto:** The Canadian Portland Cement Company; B. E. Fernow; J. Galbraith; T. P. Payne; Smith, Kerry and Chace.
**Vancouver:** J. V. Nimmo.
**Westmount:** S. R. Preston; E. B. Tilt.
**Winnipeg:** L. A. Smart.

## CANAL ZONE (PANAMA).

**Balboa:** M. E. Rupp.
**Cristobal:** R. Budd.

## CANAL ZONE.—*Continued.*

**Culebra:** A. L. Bell; F. A. Browne; H. Goldmark; E. E. Lee; T. E. L. Lipscy; A. L. Robinson; E. Schildhauer; H. F. Tucker; S. B. Williamson.

**Gatun:** C. Harding.

**Gorgona:** J. H. Flynn, Jr.

## CUBA.

**Havana:** P. D. Buzzi.

## ENGLAND.

**London:** R. Hawxhurst, Jr.; A. S. Jennings; The Paint and Varnish Society; L. S. Robertson; M. Ruthenburg; R. H. H. Stanger; M. A. Wolff.

**Sheffield:** R. A. Hadfield.

**Tredegar:** A. O. Whitehead.

**West Ealing:** J. C. Smith.

## FRANCE.

**Paris:** L. H. Fry; A. S. Garfield.

**St. Cloud:** A. Sang.

## GERMANY.

**Dusseldorf:** E. Schrodter.

**Essen:** F. Krupp Company.

## GUATEMALA.

**Guatemala City:** C. F. Novella.

## HAWAIIAN ISLANDS.

**Honolulu:** F. G. W. Cooper; J. M. Young.

## JAPAN.

**Tokio:** J. Yamaguchi.

## NOVA SCOTIA.

**Sydney:** J. P. McNaughton.

## PHILIPPINE ISLANDS.

**Manila:** Bureau of Science; G. P. Cowan.

**Olongapo:** R. E. Bakenhus

## PORTO RICO.

**San Juan:** I. A. Canals.

## RUSSIA.

**Archangel:** W. E. Taubenheim.

## SOUTH AFRICA.

**Johannesburg:** Consolidated Goldfields of South Africa, Limited; Consolidated Goldfields of South Africa, Limited—Intelligence Department.

## SPAIN.

**Madrid:** Laboratorio Central para el Ensayo de Materiales; B. O. y Roman.

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# SUMMARY OF GEOGRAPHICAL DISTRIBUTION.

| | | | | | |
|---|---|---|---|---|---|
| Alabama | 9 | Mississippi | 1 | Wisconsin | 14 |
| California | 28 | Missouri | 36 | Wyoming | 1 |
| Colorado | 8 | Montana | 3 | | |
| Connecticut | 17 | Nebraska | 4 | Australia | 2 |
| Delaware | 5 | New Hampshire | 1 | Canada | 32 |
| Dist. of Columbia | 35 | New Jersey | 50 | Canal Zone | 13 |
| Georgia | 1 | New York | 270 | Cuba | 1 |
| Idaho | 2 | North Carolina | 3 | England | 10 |
| Illinois | 99 | North Dakota | 1 | France | 3 |
| Indiana | 20 | Ohio | 63 | Germany | 2 |
| Iowa | 5 | Oklahoma | 1 | Guatemala | 1 |
| Kansas | 6 | Oregon | 4 | Hawaiian Is. | 2 |
| Kentucky | 2 | Pennsylvania | 332 | Japan | 1 |
| Louisiana | 2 | Rhode Island | 9 | Nova Scotia | 1 |
| Maine | 1 | Tennessee | 4 | Philippine Is. | 3 |
| Maryland | 18 | Utah | 2 | Porto Rico | 1 |
| Massachusetts | 83 | Virginia | 16 | Russia | 1 |
| Michigan | 17 | Washington | 8 | South Africa | 2 |
| Minnesota | 7 | West Virginia | 5 | Spain | 2 |

| | |
|---|---|
| Membership in United States | 1,193 |
| Membership in Foreign Countries | 77 |
| Total Membership | 1,270 |

# PAST OFFICERS.

The Society, from its organization in 1898 till its incorporation under its present name in 1902, was designated the American Section of the International Association for Testing Materials. The officers and members of the Executive Committee during this four-year period were as follows:

*Chairmen:*

MANSFIELD MERRIMAN, 1898–1900. HENRY M. HOWE, 1900–1902.

*Vice-Chairmen:*

HENRY M. HOWE, 1898–1900. CHARLES B. DUDLEY, 1900–1902.

*Secretaries:*

RICHARD L. HUMPHREY, 1898–1900. J. M. PORTER, 1900–1902.

*Treasurers:*

PAUL KREUZPOINTNER, 1898–1900. ROBERT W. LESLEY, 1900–1902.

*Members of Executive Committee:*

GUS. C. HENNING, 1898–1900. ALBERT LADD COLBY, 1900–1902.
MANSFIELD MERRIMAN, 1900–1902.

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The past officers and members of the Executive Committee of the American Society for Testing Materials since its incorporation under that name in 1902, are as follows:

*President:*

CHARLES B. DUDLEY, 1902–1909.

*Members of Executive Committee:*

ALBERT LADD COLBY, 1902–1905. JOHN McLEOD, 1902–1907.

## STANDING ADVISORY COMMITTEES.

### On Iron and Steel.

William R. Webster, *Chairman.*

C. Kirchhoff, H. V. Wille.

### On Cast Iron.

Henry Souther, *Chairman.*

Richard Moldenke, Thomas D. West.

### On Cement and Concrete.

Clifford Richardson, *Chairman.*

Richard L. Humphrey, Spencer B. Newberry.

### On Brick and Terra-cotta Products.

Edward Orton, Jr., *Chairman.*

H. O. Hofman, W. D. Richardson.

### On Preservative Coatings.

G. W. Thompson, *Chairman.*

Robert Job, S. S. Voorhees.

### On Tests and Testing Apparatus.

Gaetano Lanza, *Chairman.*

Mansfield Merriman, Tinius Olsen.

# TECHNICAL COMMITTEES

OF THE

# AMERICAN SOCIETY FOR TESTING MATERIALS.

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## A. FERROUS METALS.

### COMMITTEE A-1, ON STANDARD SPECIFICATIONS FOR STEEL.

WILLIAM R. WEBSTER, *Chairman.*
EDGAR MARBURG, *Secretary.*

American Steel and Wire Company,
F. H. Daniels.
Bethlehem Steel Company,
E. O'C. Acker.
Cambria Steel Company,
George E. Thackray.
Carnegie Steel Company,
W. A. Bostwick.
Central Iron and Steel Company,
James B. Bailey.
James Christie.
Charles S. Churchill.
F. H. Clark.
Albert Ladd Colby.
J. Allen Colby.
Colorado Fuel and Iron Company,
J. B. McKennan.
John Sterling Deans.
P. H. Dudley.
Franklin Institute,
Alex. E. Outerbridge, Jr.
J. E. Greiner.
Robert W. Hunt Company.
Illinois Steel Company,
P. E. Carhart.
R. K. Johnson.
Jones and Laughlin Steel Company,
Willis L. King.
E. F. Kenney.
Lackawanna Steel Company,
F. E. Abbott.
Gaetano Lanza.
Lukens Iron and Steel Company,
Charles L. Huston.
S. S. Martin.
John McLeod.
Richard Moldenke.
National Tube Company,
Frank N. Speller.
The Osborn Engineering Company,
Frank C. Osborn.
The Pennsylvania Steel Company,
J. V. W. Reynders.
L. R. Pomeroy.
Reading Iron Company.
Joseph T. Richards.
John A. Roebling's Sons Company,
H. J. Horne.
C. C. Schneider.
J. P. Snow.
Standard Steel Works,
A. A. Stevenson.
J. A. L. Waddell.
Samuel T. Wagner.
Max H. Wickhorst.
R. D. Wood and Company,
Walter Wood.

### COMMITTEE A-2, ON STANDARD SPECIFICATIONS FOR WROUGHT IRON.

(*In course of organization.*)

## COMMITTEE A-3, ON STANDARD SPECIFICATIONS FOR CAST IRON AND FINISHED CASTINGS.

WALTER WOOD, *Chairman.*
RICHARD MOLDENKE, *Secretary.*

Hugh W. Adams.
James A. Beckett
Joseph W. Bramwell
Albert Ladd Colby.
Colorado Fuel and Iron Company.
J. B. McKennan.
Edgar S. Cook.
H. A. Croxton.
George M. Davidson
H. E. Diller.
W. C. Du Comb.
B. F. Fackenthal, Jr.
L. M. Fenner.
A. I. Findley.
Stanley G. Flagg, Jr.
W. K. Hatt.
J. A. Hayes.
W. W. Hearne.
J. O. Henshaw.
P. S. Hildreth.
Henry M. Howe.
Illinois Steel Company,
P. E. Carhart.
International Harvester Company,
John G. Wood.
Robert Job.
R. K. Johnson.
Jones and Laughlin Steel Company,
Willis L. King.
J. A. Kinkead.
Paul Kreuzpointner.
Gaetano Lanza.
William W. Lobdell.
R. S. MacPherran.
Charles F. McKenna.
Mansfield Merriman.
Tinius Olsen.
Alex. E. Outerbridge, Jr
Leonard Peckitt.
Walter M. Saunders.
Albert Sauveur.
W. G. Scott.
Henry Souther.
H. W. Spangler.
Technischer Verein, Pittsburg,
Paul Bausch.
Enrique Touceda
Thomas D. West
N. B. Wittman.
E. R. Wood, Jr.
F. W. Wood.
I. H. Woolson.
C. H. Zehnder.

## COMMITTEE A-4, ON HEAT TREATMENT OF IRON AND STEEL.

HENRY M. HOWE, *Chairman.*

William Campbell.
Albert Sauveur.
Bradley Stoughton.

## COMMITTEE A-5, ON THE CORROSION OF IRON AND STEEL.

ALLERTON S. CUSHMAN, *Chairman.*
WM. H. WALKER, *Secretary.*

William Campbell.
H. M. Howe.
Robert Job.
Lukens Iron and Steel Company,
Charles L. Huston.
The National Tube Company,
F. N. Speller.
S. M. Rodgers.
Max H. Wickhorst.

## COMMITTEE A-6, ON THE MAGNETIC TESTING OF IRON AND STEEL.

CHARLES W. BURROWS, *Chairman.*

W. J. Beck.
John A. Capp.
J. W Esterline.
O. Linder.
J. A. Mathews.
A. Pinkerton.
C. E. Skinner.

## COMMITTEE A-7, ON THE TEMPERING AND TESTING OF STEEL SPRINGS AND STANDARD SPECIFICATIONS FOR SPRING STEEL.

HENRY SOUTHER, *Chairman.*

W. A. Bostwick.
H. De H. Bright
F. O. Bunnell.
F. D. Carney.
J. C. Davis.
Nathan H. Davis.
J. A. Kinkead.
Gaetano Lanza.
Alan Lukens.
R. W. Mahon.
Archibald M. McCrea
E. D. Nelson.
A. A. Stevenson
J. L. Vauclain.
Max H. Wickhorst.

## COMMITTEE A-8, ON STANDARD SPECIFICATIONS FOR COLD-DRAWN STEEL.

C. E. SKINNER, *Chairman.*

American Steel and Wire Company,
F. H. Daniels.
J. A. Capp.
Columbia Steel and Shafting Company,
A. A. Kealey.
Hartford Machine Screw Company,
P. B. Gale.
Elwood T. Ickes.
E. F. Kenney.
National Cash Register Company,
F. O. Clements.
Remington Arms Company,
Nathan A. Chase.
J. J. Shuman.
Union Drawn Steel Company,
F. N. Beegle.
Winchester Repeating Arms Company,
R. L. Penny.

## COMMITTEE A-9, ON ALLOY STEELS.

HENRY M. HOWE, *Chairman.*
WILLIAM CAMPBELL, *Secretary.*

Carpenter Steel Company,
G. W. Sargent.
John H. Hall.
E. F. Kenney.
J. A. Mathews.
G. L. Norris.
C. E. Skinner.
Henry Souther.
United States Bureau of Standards,
W. F. Hillebrand.
J. S. Unger.

## COMMITTEE A-10, ON STANDARD SPECIFICATIONS FOR STAYBOLT IRON.

H. V. WILLE, *Chairman.*

F. B. Allen.
American Iron and Steel Manufacturing Company.
Brown and Company.
F. H. Clark.
N. F. Harriman.
S. V. Hummings.
J. A. Kinkead.
E. D. Nelson.
J. C. Ramage.

## COMMITTEE A-11, ON METALLURGICAL RESEARCH IN STEEL.

(*In course of organization.*)

## COMMITTEE A-12, ON TESTS OF STEEL STRUCTURAL MEMBERS.

(*In course of organization.*)

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# B. NON-FERROUS METALS.

## COMMITTEE B-1, ON STANDARD SPECIFICATIONS FOR HARD-DRAWN COPPER WIRE.

J. A. CAPP, *Chairman.*

American Brass Manufacturing Company,
W. H. Bassett.
American Steel and Wire Company,
J. F. Tinsley.
T. D. Lynch.
John A. Roebling's Sons Company,
H. J. Horne.
Standard Underground Cable Company,
C. C. Baldwin.
Viele, Blackwell and Buck.
Waclark Wire Company,
F. W. Wallace.
Western Electric Company,
C. Crossman.
J. G. White and Company,
C. D. Gray.

## COMMITTEE B-2, ON NON-FERROUS METALS AND ALLOYS.

WILLIAM CAMPBELL, *Chairman.*

Lawrence Addicks.
Ajax Metal Company,
G. H. Clamer.
American Brass Manufacturing Company,
W. H. Bassett.
F. L. Antisell.
C. T. Bragg.
J. A. Capp.
N. F. Harriman.
T. D. Lynch.
*The Metal Industry.*
G. L. Norris.
H. E. Smith.
Henry Souther.
C. R. Spare.
E. S. Sperry.
George C. Stone.
G. W. Thompson.
United States Bureau of Standards,
W. F. Hillebrand.
W. R. Webster.
(Bridgeport Brass Company.)

## C. CEMENT AND CLAY PRODUCTS.

### COMMITTEE C-1, ON STANDARD SPECIFICATIONS FOR CEMENT.

GEORGE F. SWAIN, *Chairman.*
GEORGE S. WEBSTER, *Vice-Chairman.*
RICHARD L. HUMPHREY, *Secretary.*

Booth, Garrett and Blair.
C. W. Boynton.
Spencer Cosby.
A. W. Dow.
L. Henry Dumary.
W. S. Eames.
A. F. Gerstell.
Edward M. Hagar.
W. H. Harding.
Olaf Hoff.
H. G. Kelley.
Robert W. Lesley.
F. H. Lewis.
John B. Lober.
W. W. Maclay.
Charles A. Matcham.
Charles F. McKenna.
A. W. Munsell.
Spencer B. Newberry.
James Madison Porter
Joseph T. Richards.
Clifford Richardson.
L. C. Sabin.
Harry J. Seaman.
Henry S. Spackman Engineering Company,
Henry S. Spackman.
S. S. Voorhees.

### COMMITTEE C-2, ON REINFORCED CONCRETE.

F. E. TURNEAURE, *Chairman.*
R. W. LESLEY, *Vice-Chairman.*
RICHARD L. HUMPHREY, *Secretary.*

W. B. Fuller.
E. Lee Heidenreich.
A. L. Johnson.
Gaetano Lanza.
Edgar Marburg.
C. M. Mills
L. S. Moisseiff.
H. H. Quimby.
W. P. Taylor.
S. E. Thompson.
S. T. Wagner.
G. S. Webster.

### COMMITTEE C-3, ON STANDARD SPECIFICATIONS FOR PAVING AND BUILDING BRICK.

LOGAN WALLER PAGE, *Chairman.*
E. W. LAZELL, *Secretary.*

Ira O. Baker.
H. O. Duerr.
Edward Orton, Jr
Arthur N. Talbot.
Ira H. Woolson.

### COMMITTEE C-4, ON STANDARD SPECIFICATIONS AND TESTS FOR CLAY AND CEMENT SEWER PIPES.

RUDOLPH HERING, *Chairman.*
A. J. PROVOST, JR., *Vice-Chairman.*
E. J. FORT, *Secretary.*

F. A. Barbour.
W. F. Dunspaugh.
H. P. Eddy.
C. D. Hill.
M. A. Howe.
R. L. Humphrey.
G. Kauffman.
Coleman Meriwether.
A. E. Phillips.
J. C. Rossi.
John J. Starr.
A. N. Talbot.
John T. Wallace.
George S. Webster.

### COMMITTEE C-5, ON FIREPROOFING MATERIALS.

IRA H. WOOLSON, *Chairman.*
R. P. MILLER, *Secretary.*

W. W. Ewing.
John R. Freeman.
H. W. Hodge.
C. W. Sommerville.
Edwin Thacher.
D. E. Waid.

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## D. MISCELLANEOUS MATERIALS.

### COMMITTEE D-1, ON PRESERVATIVE COATINGS FOR STRUCTURAL MATERIALS.

S. S. VOORHEES, *Chairman.*
G. B. HECKEL, *Vice-Chairman.*
G. W. THOMPSON, *Secretary.*

W. A. Aiken.
Thomas B. Akin.
James Christie.
A. S. Cushman.
George M. Davidson.
Joseph Dixon Crucible Company,
  Malcolm MacNaughton.
A. W. Dow.
S. M. Evans.
C. N. Forrest.
Henry A. Gardner.
James H. Gibboney.
A. H. Gill.
F. H. Glidden.
A. P. Hume.
F. P. Ingalls.
International Acheson Graphite Company,
  W. Acheson Smith.
Robert Job.
Frank S. Low.
Lowe Brothers Company,
  Houston Lowe.
John Lucas Company,
  F. A. Lane.
Charles Macnichol.
P. C. McIlhiney.
Robert S. Perry.
Anderson Polk.
Allen Rogers.
A. H. Sabin.
W. G. Scott.
F. P. Smith.
Wirt Tassin.
M. Toch.
United States Gutta Percha Paint Company,
  H. W. Rice.

COMMITTEE D-1.—*Continued.*

C. P. Van Gundy.
Joseph F. Walker.
Percy H. Walker.
Wm. H. Walker.
Westinghouse, Church, Kerr and Company,
C. M. Chapman.
M. H. Wickhorst.
A. Wilhelm Company,
W. S. Davis.
P. Wilkins.

## COMMITTEE D-2, ON STANDARD TESTS FOR LUBRICANTS.

A. H. GILL, *Chairman.*
J. M. JEFFERS, *Secretary.*

W. A. Converse.
W. M. Davis.
A. W. Dow.
J. L. Gray.
T. T. Gray.
A. P. Hume.
E. D. Nelson.
J. H. Pew.
S. W. Stratton.
George H. Taber.
C. E. Ward.

## COMMITTEE D-3, ON STANDARD METHODS OF ANALYSIS OF FATS AND OILS.

C. N. FORREST, *Chairman.*

Jerome W. Frank.
G. W. Thompson.

## COMMITTEE D-4, ON STANDARD TESTS FOR ROAD MATERIALS.

LOGAN WALLER PAGE, *Chairman.*
PRÉVOST HUBBARD, *Secretary.*

American Asphaltum and Rubber Company,
H. B. Pullar.
Ira O. Baker.
A. H. Blanchard.
W. H. Broadhurst.
W. W. Crosby.
A. S. Cushman.
A. W. Dow.
C. N. Forrest.
W. H. Fulweiler.
R. S. Greenman.
W. K. Hatt.
G. P. Hemstreet.
J. A. Holmes.
Joseph W. Hunter.
Arthur N. Johnson.
A. Marsten.
Clifford Richardson.
Albert Sauveur.
P. P. Sharpless.
F. P. Smith.
Herbert Spencer.
Standard Asphalt and Rubber Company,
W. A. Levering.
Calvin Tomkins
United Gas Improvement Company.
W. H. Gartley.
Warren Brothers Company,
A. E. Schutte.

## COMMITTEE D-5, ON STANDARD SPECIFICATIONS FOR COAL.

J. A. HOLMES, *Chairman.*
B. F. BUSH, *Secretary.*

H. C. Adams.
John B. Atkinson.
Edwin G. Bailey.
George H. Barrus.
A. W. Belde.
A. Bement.
W. H. Blauvelt.
William Brady.
W. C. Bullitt.
F. N. Bushnell.
J. A. Capp.
F. D. Carney.
F. B. Carpenter.
Dyer O. Clark.
J. F. Deemes.
P. L. Dougherty.
Anton Eilers.
R. H. Fernald.
Thomas Fisher.
Henry S. Fleming.
Alfred E. Forstall.
Fuel Engineering Company,
E. H. Cheney.
O. L. Garrison.
W. D. Gates.
A. W. Gibbs.
W. F. M. Goss.
Frank R. Haas.
Edward M. Hagar.
J. R. Harris.
A. P. Hume.
John H. Jones.
John L. Kemmerer.
W. A. Lathrop.
Robert W. Lesley.
Andrew S. McCreath and Son,
Andrew S. McCreath.
Robert Mitchell.
Richard Moldenke.
Edward Orton, Jr.
William N. Page.
S. W. Parr.
D. T. Randall.
George S. Rice.
Roberts and Schaefer Company,
Frank E. Mueller.
C. S. Robinson.
G. W. Schleuderberg.
Carl Scholz.
L. S. Storrs.
Edward H. Taylor.
Priestley Toulmin.
United Gas Improvement Company,
Walton Clark.
S. S. Voorhees.
F. R. Wadleigh.
Alfred H. White.
John H. Winder.
J. E. Woodwell.

## COMMITTEE D-6, ON STANDARD SPECIFICATIONS FOR COKE.

C. H. ZEHNDER, *Chairman.*
RICHARD MOLDENKE, *Secretary.*

Anaconda Copper Mining Company,
E. P. Mathewson.
A. W. Belden.
W. H. Blauvelt.
Wm. A. Bole.
Edgar S. Cook.
John P. Donohoe.
B. F. Fackenthal, Jr.
H. L. Haldeman.
J. A. Holmes.
J. A. Kinkead.
John Lloyd.
Thomas Lynch.
T. D. Lynch.
F. Schniewind.
W. G. Scott.
Henry Souther.
D. B. Wentz.
H. V. Wille.
N. B. Wittman.
Walter Wood.

## COMMITTEE D-7, ON STANDARD SPECIFICATIONS FOR THE GRADING OF STRUCTURAL TIMBER.

HERMANN VON SCHRENK, *Chairman.*
W. K. HATT, *Secretary.*

Charles H. Davis.
A. O. Elzner.
B. E. Fernow.
I. H. Fetty.
H. W. Lohmann.
R. A. Long
A. N. Mansfield.
A. F. Rosenheim
E. J. Russell.

## COMMITTEE D-8, ON WATERPROOFING MATERIALS.

W. A. AIKEN, *Chairman.*
A. W. DOW, *Secretary.*

Barrett Manufacturing Company,
W. S. Babcock.
S. R. Church.
E. W. DeKnight.
C. de Wyrall.
T. H. Ellis.
J. L. Gray.
A. W. Munsell.
C. S. Reeve.
W. P. Taylor.
Maximilian Toch.
L. W. Walter.
Warren Brothers Company,
A. E. Schutte.

## COMMITTEE D-9, ON STANDARD TESTS OF INSULATING MATERIALS.

C. E. SKINNER, *Chairman.*
G. A. JACOBS,* *Secretary.*

Commonwealth-Edison Company,
E. O. Schweitzer.
Electrical Testing Laboratories,
Clayton H. Sharp.
Wm. C. Geer.
General Electric Company,
J. A. Capp.
The Locke Insulator Company,
Walter T. Goddard.
Schenectady Varnish Company,
W. H. Wright.
Standard Underground Cable Company,
H. W. Fisher.
United States Bureau of Standards,
H. B. Brooks.
Western Electric Company,
G. Crossman.

* Representing The Sherwin-Williams Company.

## COMMITTEE D-10, ON STANDARDIZING EXPLOSIVES.

C. E. MUNROE, *Chairman.*

H. N. Barksdale.
A. C. Blum.
B. W. Dunn.
A. G. Fay.
J. A. Holmes.

## E. MISCELLANEOUS SUBJECTS.

### COMMITTEE E-1, ON STANDARD METHODS OF TESTING.

GAETANO LANZA, *Chairman.*

W. A. Bostwick.
Wm. Campbell.
James Christie.
John S. Deans.
Henry Fay.
W. K. Hatt.
J. E. Howard.
Henry M. Howe.
A. P. Hume.
Richard L. Humphrey.
Robert Job.
O. Linder.
Mansfield Merriman.
Richard Moldenke.
E. D. Nelson.
H. P. Talbot.
Geo. E. Thackray.
J. L. Vauclain.
Ira H Woolson.

### COMMITTEE E-2, ON UNIFORM SPECIFICATIONS FOR BOILERS.

E. D. MEIER, *Chairman.*

F. B. Allen.
R. C. Carpenter
H. J. Hartley.
Charles L. Huston.
R. K. Johnson.
John McLeod.

### COMMITTEE ON METHODS OF SAMPLING AND ANALYSIS OF COAL.

(Forming part of a joint committee on this subject with a committee of the American Chemical Society.)

Frank Haas. S. W. Parr. S. S. Voorhees.

# REGULATIONS GOVERNING TECHNICAL COMMITTEES.

*Creation.*—The creation of a technical committee shall be subject to the authorization of the Executive Committee, acting either on a recommendation adopted by majority vote at an annual meeting of the Society, or on its own initiative.

*Appointments.*—Appointments on technical committees shall be made by the Executive Committee subject to the following provisions:

1. On committees dealing with subjects having a commercial bearing, either an equal numeric balance shall be maintained between the representatives of consuming and producing interests; or the former may be allowed to predominate with the acquiescence of the latter. Unattached experts shall be classed with the representatives of consuming interests.
2. Additional appointments on existing committees shall be made only on the recommendation of, or with the approval of, such committees.
3. Only members of the Society shall be eligible, in general, to appointment on committees, although exceptions may be authorized by the Executive Committee in favor of representatives of government branches or other societies.

*Preliminary Organization.*—The President of the Society will appoint the chairman *pro tem.* of a new committee from the representatives of the consuming interests and unattached experts. The chairman *pro tem.*, after communicating with the other members of the committee, will fix the place and time of the first meeting. He may, at his discretion, appoint one or more members of the committee to prepare matter in advance for consideration at that meeting or he may prepare such matter himself. This procedure is recommended as calculated to economize time at the meeting and to afford a definite basis for discussion.

*Permanent Organization.*—At the first meeting of a committee a permanent organization shall be effected by the election of a permanent chairman from among the representatives of consuming interests and unattached experts, and such other officers and sub-committees as the committee may desire. The duties

and powers assigned to these officers and sub-committees, and the details of management and administration in general, shall be at the discretion of each committee, subject to the limitations of these regulations.

*Reports.*—The reports of technical committees shall be presented at the annual meetings. Reports embodying any features on which specific action on the part of the Society is recommended by the committee, must first have been submitted to letter ballot of the committee, and such features must have received the approval of the majority of those voting. Dissenting members shall have the right to present minority reports individually or jointly.

*Specifications.*—Proposed new and standard specifications or the proposed amendment of existing specifications must originate in the particular committee within whose province such specifications properly belong. No action affecting specifications shall be taken by any technical committee except at meetings called for that purpose. Action at such meetings shall be subject to majority vote of those voting, and subsequently to majority vote of those voting on letter ballot of the entire committee. Dissenting members shall have the right to present minority reports, individually or jointly, at the annual meeting of the Society at which the majority report is presented.

Any recommendations affecting specifications presented by the appropriate committees at the annual meetings of the Society may be amended by a majority vote of those voting, and the final adoption of new or amended specifications shall be subject to the following procedure:

1. Approval at an annual meeting by two-thirds vote of those voting.
2. Approval by letter ballot of the Society by two-thirds vote of those voting.

*Cooperation with Other Committees.*—A committee may, at its discretion, invite the cooperation of committees of other societies on like or cognate subjects, provided such relations shall entail no obligations at variance with these regulations, and shall impose no restrictions upon the free and independent action of the committee.

A committee desiring to bring about the appointment of similar committees by other societies for purposes of cooperation shall address a recommendation to that effect to the Executive Committee and, on the approval of the latter, negotiations to the

desired end shall be conducted on behalf of the Executive Committee by the Secretary of the Society.

*Publications.*—Committees shall have no right to issue matter for publication through other than the regular Society channels, unless so authorized, for exceptional reasons, by the Executive Committee.

*Current Expenses.*—The current expenses of committees for stationery and postage will be assumed by the Society. Stationery of standard form will be furnished by the Secretary of the Society on application of the chairman or secretary of a committee. Expenses for postage will be paid by the Treasurer of the Society on vouchers approved by the chairman of a committee.

*Extraordinary Expenses.*—Expenses for items other than stationery and postage will not be assumed by the Society, unless such expenditures were incurred in pursuance of authorization of the Executive Committee, on recommendation of the chairman of the committee concerned, and within amounts specifically fixed by the Executive Committee.

*Special Funds.*—Committees engaged on subjects having a commercial bearing shall be authorized to solicit contributions from manufacturers towards research funds. Contributions from consumers to funds for this and other purposes shall be solicited only by the Executive Committee. All funds thus collected shall be transmitted to the Treasurer of the Society and deposited by him in bank and placed to the credit of the committees on the books of the Society, subject to disbursement only on vouchers signed by the chairman of the committee concerned.

*Salaries and Fees.*—Committees shall not be authorized to pay salaries or professional fees in any form to any of their officers or members. Assistants in connection with research work may be engaged at salaries or special compensation fixed by the committees concerned, provided that funds for such salaries or compensations shall previously have been deposited with the Treasurer of the Society. Payments for such purposes shall be made by the Treasurer of the Society only on vouchers approved by the chairman of the committee concerned.

*Discharge of Committees.*—Technical committees may be discharged by the Executive Committee, either at their own request or with their consent, on the completion of the work for which they were appointed or in consequence of protracted inactivity.

# THE INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.

## OFFICERS.

*Acting President.*

HENRY M. HOWE.

*Vice-Presidents.*

A. MARTENS. N. BELELUBSKY.

## MEMBERS OF COUNCIL.

Every country having a membership of twenty or more in the Association is entitled to a representative on the Council. For those having a membership of less than twenty, mandataries are appointed by the Council.

*Life Members.*

FRANZ BERGER. ALEXANDER FOSS.

*Elected Members.*

Australia—W. H. WARREN.
Austria—B. KIRSCH.
Belgium—A. GREINER.
Denmark—H. I. HANNOVER.
France—A. MESNAGER.
Germany—A. MARTENS.
Great Britain—G. C. LLOYD.
Holland—L. BIENFAIT.
Hungary—A. REJTÖ.
Italy—J. BENETTI.
Norway—S. A. LUND.
Roumania—C. M. MIRONESCO.
Russia—N. BELELUBSKY.
Spain—J. MARVA Y. MAYER.
Sweden—J. O. ROOS AF HJELMSÄTER.
Switzerland—F. SCHÜLE.
United States of America—HENRY M. HOWE.

## MANDATARIES.

Finland—A. GRANFELT.
Luxembourg—E. BIAN.
Portugal—J. DA P. CASTANHEIRO DAS NEVES.
Servia—M. MILASINOVIC.

*General Secretary.*

ERNST REITLER.

Nordbahnstrasse 50, Vienna, II, Austria.

Communications for the International Association should be directed to the International Association for Testing Materials, Nordbahnstrasse 50, Vienna, II, Austria.

# THE INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.

## BY-LAWS.

Adopted at the Budapest Congress, 1901.
Amended at the Brussels Congress, 1906, and at the Copenhagen Congress, 1909.

SECTION 1. The Association shall be called "THE INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS."

SEC. 2. The objects of the Association are: the development and unification of standard methods of testing; the examination of the technically important properties of materials of construction and other materials of practical value, and also the perfecting of apparatus used for this purpose.

These objects will be furthered:

1. By the Congresses and other meetings of the Association.
2. By the publication of an official Journal.
3. By any other means that may appear desirable.

SEC. 3. The funds necessary for carrying out the purposes mentioned in Section 2 will be raised by

1. The annual subscriptions of members.
2. Profits from the official Journal.
3. Other contributions.

SEC. 4. Any person can become a member upon being proposed by two members of the Association.

Official bodies and technical societies can enter direct on their sending in their application for membership.

Applications for membership must be sent in writing to the President or to a member of the Council.

Resignations of membership must also be sent in the same way.

SEC. 5. It is the duty of every member to further the interests of the Society to the best of his ability.

Every member is required to pay an annual subscription of at least 8 Mks. =8 shillings = $2.00.*

* Subscriptions are to be paid to the duly appointed collectors in each country, the card of membership serving as a receipt. Subscriptions not paid by the first of July are collected through the post-office.

The Council is authorized to increase the annual subscription in order to cover extraordinary expenses incurred in the interests of the Association.

SEC. 6. Every member has the right to obtain the "Proceedings" of the Association, during the period for which his subscription has been paid.

SEC. 7. The Association will hold a Congress, as a rule, every second year.

The arrangements for the Congresses will be discussed in General Meetings and in meetings of the different sections.

Sections will be formed for the different groups of materials as may be considered necessary.

At present there are three sections:

I. Metals.

II. Natural and artificial building stones, cements and mortars.

III. Other materials of practical value.

Any special questions relating to the subjects of the different sections will be considered at sectional meetings.

The members assisting at the sectional debates, under the presidency of a member of the Council, will appoint the committees of the different sections.

The results of the deliberations of the different sections must be communicated at a General Meeting, which will pass resolutions embodying the proposals of the sections.

Reports of Commissions, proposals of the Council and other matters to be laid before the Congress, will be printed in German, French and English, and will be sent (in the language preferred) to all members who have announced their intention of taking part in the Congress, within fourteen days before the meeting of the Congress, if possible.

The decisions of the Congress will be printed in all three languages and sent to all members of the Association.

SEC. 8. The Council of the Association will transact all necessary business connected with the Association.

The Council will consist of the President and the duly elected members.

Every country represented in the Association by at least twenty members has the right to elect one member as member of the Council. For those countries where the number of members

is under twenty, the Council appoints a Mandatary who takes part in the Council's Meeting with voting powers.

The President will be elected by the Congress, the Council by the members belonging to the different countries.

Till such election has taken place the former members of the Council remain in office.

The names of proposed new members of the Council have to be communicated to the President before each Congress.

The two Vice-Presidents will be elected by the Council from among its own members.

The Council has the power to elect Past Presidents as permanent members of Council.

The Council is entitled to transact business when it has been duly called together according to rule and when the President or one of the Vice-Presidents is present.

Retiring members of the Council are eligible for re-election.

If a member of the Council resigns during his term of office, the President shall immediately direct the election of a successor by the members belonging to the country in question.

In the event of the death or resignation of the President, the Council will appoint one of its members to carry on the presidential duties till the next Congress.

The term of office of the Council lasts from one Congress till the next.

SEC. 9. The business of the Association will be attended to by a salaried General Secretary under the direction of the President.

The members of the Council will attend to the business of the Association in the country which they represent.

SEC. 10. The resolutions of the Congresses on technical questions merely serve to express the opinion of the majority. They are therefore in the form of recommendations and are in no way binding.

SEC. 11. The resolutions of the Congresses can only be carried if at least three-fourths of the recorded votes are in favor of them. Every member of the Association present, as well as every representative of official bodies and technical societies, has one vote.

The rights and duties of a member of the Association are not altered by the fact of his belonging at the same time to a national or other Association, which Association is itself a member of the International Association.

SEC. 12. The technical problems to be considered by the Association will be decided upon by the Congresses and by the Council, and will be duly referred to commissions or referees appointed by the Council,

SEC. 13. The Council draws up its own regulations according to the By-Laws of the Association and to the needs which may from time to time present themselves.

SEC. 14. In the event of the Association being dissolved, any funds belonging to it will be handed over to the "International Red Cross Association."

# THE INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.

## TECHNICAL PROBLEMS, COMMITTEES* AND REFEREES.

As constituted in February, 1910.

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## A. METALS.

**Problem 1.**—On the basis of existing specifications, to seek methods and means for the introduction of international specifications for testing and inspecting iron and steel of all kinds. (Proposed at the Zurich Congress, 1895; enlarged at the Budapest Congress, 1901.)

*Committee:*

*Chairman.*—A. Rieppel, Aeussere Cramer-Klettstrasse 12, Nuremburg, Germany.

*American Members.*—James Christie; Carnegie Steel Company, represented by W. A. Bostwick; Henry M. Howe; Paul Kreuzpointner; Richard Moldenke.

**Problem 1a.**—On the basis of unified specifications recognized in the various countries, to attempt the introduction of international unified specifications for iron and steel of all kinds. (Drawn up at the Twentieth Council's Meeting, 1910.)

*Committee:*

*Chairman.*—A. Rieppel, Aeussere Cramer-Klettstrasse 12, Nuremburg, Germany.

*American Member.*—Henry M. Howe.

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*The names of only the Chairmen, the Vice-Chairmen, and American Members of International Committees are here given.

**Problem 2.**—To establish methods of inspection and testing for determining the uniformity of individual shipments of iron and steel. (Proposed at the Stockholm Congress, 1897.)

**Problem 4.**—Methods for testing welds and weldability. (Proposed at the Zurich Congress, 1895.)

**Problem 24.**—On uniform nomenclature of iron and steel. (Resolution of Council, February 3, 1901.)

*Committee:*

*Chairman.*—H. M. Howe, Broad Brook Road, Bedford Hills, N. Y.

*Vice-Chairmen.*—L. Lévy, Rue de La Rochefoucauld 19, Paris, France; D. Tschernoff, Rue Pessotschnaya 25, St. Petersburg, Russia.

*Secretary.*—Albert Sauveur, Rotch Building, Harvard University, Cambridge, Mass.

*American Member.*—W. Campbell.

**Problem 25.**—To draw up methods of testing cast iron and finished castings. (Proposed at the Budapest Congress, 1901; altered at the Twentieth Council's Meeting in the sense of the Copenhagen Congress resolution.)

**Problem 26.**—Collection of data which permit the ascertaining of relations between the properties revealed by impact tests on notched bars and the behavior of the pieces in service. Comparison of results obtained with various apparatus. (Resolution of the Copenhagen Congress, 1909.)

*Chairman.*—G. Charpy, Montluçon, France.

**Problem 27.**—Ascertaining of the relations between the different methods for determining hardness and fixing the numerical values thus obtained representing the different properties of metals. (Proposed at the Budapest Congress, 1901.)

**Problem 28.**—The consideration of the magnetic and electric properties of materials in connection with their mechanical testing. (Proposed at the Budapest Congress, 1901.)

**Problem 38.**—The principles for specifications of copper and copper alloys are to be studied. (Proposed at the Brussels Congress, 1906; enlarged at the Copenhagen Congress, 1909.)

*Committee:*

*Chairman.*—Léon Guillett, 8, Avenue des Ternes, Paris, XVIIe, France.
*American Members.*—C. E. Skinner; H. E. Diller.

**Problem 44.**—Relations between the chemical composition, the thermic treatment, and the properties of special steels. (Drawn up at the Twentieth Council's Meeting, 1910.)

**Problem 45.**—Studying methods for determining the enclosures, their influence upon the mechanical properties of metallurgical products, and for the study of this question on the whole. (Drawn up at the Copenhagen Congress, 1909.)

**Problem 46.**—Drawing up of unified tests for the resistance of metals to mechanical wear. (Proposed at the Copenhagen Congress, 1909.)

**Problem 47.**—Methods for ascertaining the resistance of metals to alternating stresses. (Drawn up at the Twentieth Council's Meeting, 1910.)

**Problem 48.**—Influence of increased temperature on the working of metals. (Drawn up at the Twentieth Council's Meeting, 1910.)

**Problem 49.**—Classification of pig iron. To ascertain how far specification on analysis may be substituted for the method of grading by fracture appearance. (Drawn up at the Copenhagen Congress, 1909.)

Referred to Committee 1a.

## B. HYDRAULIC CEMENTS, STONES, AND CONCRETE.

**Problem 7.**—On the relation of chemical composition to the weathering qualities of building stones; the influence of smoke, especially sulphurous acid, on building stones; the weathering qualities of roofing slates. (Proposed at the Zurich Congress, 1895.)

*Committee:*

*Chairman.*—A. Hanisch, Währingstrasse 59, Vienna, IX, Austria.
*Vice-Chairman.*—P. Larivière, 170, Quai de Jemmapes, Paris, Xe, France.
*American Member.*—Mansfield Merriman.

**Problem 9.**—On rapid methods for determining the strength of hydraulic cements. (Proposed at the Zurich Congress, 1895.)

*Committee:*

*Chairman.*—F. Berger, Schottenfeldgasse 37, Vienna, VII, Austria.
*American Members.*—W. W. Maclay; Charles F. McKenna.

**Problem 10.**—To digest and evaluate the resolutions of the conferences of 1884-1893 concerning the adhesive qualities of hydraulic cements. (Proposed at the Zurich Congress, 1895.)

**Problem 11.**—To establish methods for testing puzzolanas, with the object of determining their value for mortars. (Proposed at the Zurich Congress, 1895.)

*Committee:*

*Chairman.*—G. Herfeldt, Andernach a. Rh., Germany.
*Vice-Chairman.*—C. Segré, Rome, Italy.
*American Member.*—A. Lundteigen.

**Problem 12.**—Investigation on the behavior of cements as to time of setting, and on the best method for determining the beginning and the duration of the process of setting, with special reference to ball pressure tests. (Proposed at the Zurich Congress, 1895; enlarged in conformity with the resolution of the Budapest

Congress, 1901; completed at the Twentieth Council's Meeting, 1910.)

**Problem 30.**—Determination of the simplest method for the separation of the finest particles in Portland cement by liquid and air processes. (Proposed at the Budapest Congress, 1901.)

*Committee:*

*Chairman.*—M. Gary, Gross-Lichterfelde, W., Germany.
*American Member.*—Henry S. Spackman Engineering Company.

**Problem 31.**—On the behavior of cement in sea water. (*a*) Additional information to the reports presented at the Copenhagen Congress, 1909, and information on the effect of sea water on Portland-cement sea structures of more than twenty-five years' standing. (*b*) Study of the effect of sea water on specially prepared cements. (Proposed at the Budapest Congress, 1901; completed at the Copenhagen Congress, 1909.)
*Referee to Problem* (*a*).—E. Leduc, Paris, France.

*Committee* (*b*):

*Chairman.*—E. Leduc, Paris, France.
*American Member.*—Robert W. Lesley.

**Problem 32.**—On accelerated tests of the constancy of volume of cements. (Decision of the Zurich Congress, 1895.)

**Problem 40.**—Study of the unification of specifications for gypsum. (Proposed at the Brussels Congress, 1906.)

**Problem 41.**—Investigations of reinforced concrete. (Proposed at the Brussels Congress, 1906.)

*Committee:*

*Chairman.*—F. Schüle, Polytechnikum, Zurich, Switzerland.
*Vice-Chairmen.*—M. Germelmann, W. Wilhelmstrasse 80, Berlin; A. N. Talbot, University of Illinois, Urbana, Ill.
*American Member.*—R. L. Humphrey; F. E. Turneaure.

**Problem 42.**—Uniform tests of hydraulic cements by prisms, and determination of a standard sand. (Proposed at the Brussels Congress, 1906.)

*Committee:*

*Chairman.*—F. Schüle, Polytechnikum, Zurich, Switzerland.
*American Member.*—R. L. Humphrey.

**Problem 50.**—On the influence of the composition of the mortar and the quality of the building stone on the weathering of masonry. (Proposed at the Copenhagen Congress, 1909.)

*Chairman.*—A. van der Kloes, Delft, Holland.

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## C. MISCELLANEOUS.

**Problem 18.**—On the methods of testing the protective power of paints used on metallic structures. (Proposed at the Zurich Congress, 1895.)

**Problem 34.**—Fixing a uniform definition and nomenclature of the bitumens. (Proposed at the Budapest Congress, 1901.)

*Referee.*—D. Holde, Gross-Lichterfelde, W., Germany.

**Problem 35.**—Study of the methods of testing caoutchouc. (Proposed at the Budapest Congress, 1901.)

*Chairman.*—E. Camerman, 31 Square-Guttenberg, Brussels, Belgium.

**Problem 39.**—Study of the principles of specifications of oil for technical purposes. (Proposed at the Brussels Congress, 1906.)

*Committee:*

*Chairman.*—M. Albrecht, Hamburg, Germany.
*Vice-Chairman.*—E. Camerman, 31 Square-Guttenberg, Brussels, Belgium.
*American Member.*—A. H. Gill.

**Problem 51.**—Examination into the desirability of making wood tests on larger pieces containing defects or variations in structural form instead of limiting the tests to small perfect pieces. (Drawn up at the Copenhagen Congress, 1909.)

*Referee.*—M. Rudeloff, Gross-Lichterfelde, Germany.

**Problem 52.**—Nomenclature of certain technical qualities connected with internal strains. (Drawn up at the Twentieth Council's Meeting, 1910.)

*Chairman.*—A. Mesnager, 182 Rue de Rivoli, Paris, I, France.

# SUMMARY OF THE PROCEEDINGS OF THE THIRTEENTH ANNUAL MEETING.

ATLANTIC CITY, N. J., JUNE 28-JULY 2, 1910.

THE THIRTEENTH ANNUAL MEETING OF THE AMERICAN SOCIETY FOR TESTING MATERIALS was held at the Hotel Traymore, Atlantic City, N. J., on June 28-July 2, 1910. The total attendance at the meeting, including guests, was 347.

The following members were present or represented at the meeting:

Abraham, Herbert.
Adams, H. C.
Adams, J. K.
Aiken, W. A.
Ajax Metal Company,
G. H. Clamer.
Akin, Thomas B.
Allen, Irving C.
American Asphaltum and Rubber Company, H. B. Pullar.
American Brass Company,
William H. Bassett.
American Bridge Company,
A. J. Christie.
American Foundrymen's Association, Richard Moldenke.
*American Machinist*,
L. P. Alford.
American Steel and Wire Company,
J. F. Tinsley.
Antisell, F. L.
Atwood, J. A.

Backert, A. O.
Barrett Manufacturing Company,
William S. Babcock.
Bateman, T. J.
Baxter, Florus R.
Beale, H. A., Jr.
Berger Manufacturing Company,
A. T. Enlow.
Berry, H. C.
Bethlehem Steel Company, The,
E. O' C. Acker.
Bird, Robert Montgomery.
Blackmer and Post Pipe Company,
L. G. Blackmer.
Bleininger, A. V.
Bonzano, A.
Bostwick, W. A.
Bowman, Austin Lord.
Boylston, H. M.
Boynton, C. W.
Buck, D. M.
Buffalo, Rochester and Pittsburg Railway, H. G. Burnham.
Burrows, Charles W.
Butler, George.

Campbell, Charles M.
Capp, J. A.
Carbon Steel Company,
Harry W. Finnell.
Carnegie Steel Company,
W. A. Bostwick.
Carney, F. D.
Carpenter, A. W.
Carpenter Steel Company,
J. H. Parker.
Charls, G. H.
Chen, Wei Fan.
Christie, A. J.

Christie, James.
Church, Sumner R.
Churchill, Charles S.
Clements, Frank O.
Colby, Albert Ladd.
Colby, J. A.
Conradson, P. H.
Cook, H. E.
Corse, William M.
Corson, Charles E.
Cushman, Allerton S.

Davidson, G. M.
Davis, Eugene R.
Davis, William M.
Davis, William R.
Decker, Burton C.
DeKnight, Edward W.
Derby, W. A.
Dewar, John.
De Wyrall, Cyril.
Diller, H. E.
Dixon Crucible Company, Joseph, M. McNaughton.
Donohoe, John P.
Douty, D. E.
Dow, Allan W.
Drinker, Henry S.
Duerr, H. O.
Dunn, B. W.
Dunning, Hubert.

Easby, M. Ward.
Eisenschiml, Otto.
Electrical Testing Laboratories, F. M. Farmer.
Elmquist, F. A.
*Engineering News*, Frank C. Wight.
*Engineering Record*, John M. Goodell.

Farmer, F. M.
Ferguson, Lewis R.
Fireman, Peter.
Fisher, Henry W.
Force, Henry J.
Forrest, C. N.
Forstall, Alfred E.
Foster, H. W.
Fuller, Almon H.
Fulweiler, W. H.

Gaines, Richard H.
Gardner, Henry A.
General Electric Company, J. A. Capp.
Gibboney, James H.
Gill, Augustus H.
Goldbeck, Albert T.
Goodell, John M.
Greenman, Russell S.
Griffith, R. E.

Hall, John H.
Hancock, E. L.
Heckel, G. B.
Heidenreich, E. Lee.
Hemstreet, George P.
Hilles, Raymond W.
Hokanson, Martin.
Howard, James E.
Howard, J. W.
Howe, Henry M.
Hubbard, Prévost.
Huber, Frederick W.
Humphrey, Richard L.
Hunnings, S. V.
Hunt, Robert W.
Hunter, Joseph W.

Ickes, E. T.
Illinois Steel Company, W. C. Post.
Ingalls, F. P.
*Iron Age, The*, A. I. Findley,
*Iron Trade Review, The*, A. O. Backert.

Jeffers, John M.
Johnson, A. L.
Johnson, R. K.
Jones and Laughlin Steel Company, The, Jesse J. Shuman.

Kenney, L. H.

Kinkead, J. A.
Kinney, William M.
Koch, George B.
Kohr, Donald A.

Lackawanna Steel Company,
F. E. Abbott.
Lanza, Gaetano.
Lawson, T. R.
Lazell, E. W.
Lesley, Robert W.
Linder, Oscar.
Little, Arthur D., Inc.,
Hervey J. Skinner.
Loudenbeck, H. C.
Low, Frank S.
Lowe Brothers Company, The,
L. H. McFadden.
Lucas and Company, John,
F. A. Lane.
Lukens, Alan N.
Lum, D. W.
Lynch, F. D.
Lyon, Frank.

Macgregor, James S.
Macnichol, Charles.
MacPherran, R. S.
Mahon, R. W.
Mannhardt, Hans.
Marburg, Edgar.
Masury and Son, J. W ,
F. P. Ingalls.
Matchem, Charles A.
Mathews, John A.
McCleary, E. T.
McCready, Ernest B.
McDonnell, M. E.
McGrady, J. W.
McNaugher, D. W.
Meade, Richard K.
Meriwether, Coleman.
*Metal Industry, The*,
L. J. Krom.
Midvale Steel Company,
Radclyffe Furness.
Miller, Rudolph P.
Mills, Charles M.
Missouri Pacific Railway,
W. J. Burton.
Moisseiff, Leon S.
Moldenke, Richard.
Moore, H. F.
Moyer, Albert.
Munsell, A. W.

National Cash Register Company,
The, F. O. Clements.
National Tube Company,
F. N. Speller.
Neal, C. S.
New Jersey Zinc Company,
G. C. Stone.
Norris, George L.

Olsen, Tinius,
T. Y. Olsen.

Page, L. W.
Page, W. Marshall.
Pennsylvania Steel Company, The,
J. V. W. Reynders.
Perry, R. S.
Pew, J. Howard.
Pickard, Glenn H.
Pittsburg Testing Laboratory,
John M. Bailey.
Polk, Anderson.
Porter, J. Madison.
Post, W. C.
Potts, Stephen C.
Powers, W. A.
Price, Charles P.
Provost, A. J., Jr.

Remington Arms Company,
N. A. Chase.
Reynders, J. V. W.
Richardson, Clifford.
Riehlé, Frederick A.,
William J. Tretch.
Roberts, J. C.
Robinson, F. W.,
R. W. Lindsay.
*Rock Products*,
Fred. K. Irvine.

Rodman, H. B.
Roebling's Sons Company, J. A.,
H. J. Horn.
Rogers, Allen
Rys, C. F. W.

Sabin, A. H.
Sanborn, J. R.
Schenectady Varnish Company,
W. H. Wright.
Sharpless, Philip P.
Sherrerd, John M.
Sherwin-Williams Company, The,
Edward C. Holton.
Shore, Albert F.
Shuman, Jesse J.
Skinner, C. E.
Skinner, Hervey J.
Slocum, C. L.
Smith, Earl B.
Smith, Francis P.
Smith, H. E.
Sommer, Albert.
Souther, Henry.
Spackman Engineering Company,
H. S., Henry S. Spackman.
Stafford, Samuel G.
Standard Steel Works,
A. A. Stevenson.
Standard Underground Cable Company, The, H. W. Fisher.
Stevenson, A. A.
Stone, George C.
Stoughton, Bradley.
Studebaker Brothers' Manufacturing Company, J. A. White.

Talbot, A. N.
Tassin, Wirt.
Taylor, Knox.
Testing Laboratory, City of St. Louis,
W. L. Hempelmann.
Mont Schuyler.
Thomas, 3d, George.
Thompson, G. W.
Tiemann, Hugh P.
Tilt, Edward B.
Tretch, William J.
Trist, N. B.

University of Pittsburg,
J. Hammond Smith.

Van Gundy, C. P.
Voorhees, S. S.

Waldo, Leonard.
Walker, J. F.
Walker, Percy H.
Warner, George C.
Western Electric Company,
Oscar Linder.
Westinghouse, Church, Kerr and
Company, C. M. Chapman.
Westinghouse Electric and Manufacturing Company,
C. E. Skinner.
Wetherill, C. T.
White, George D.
Wickhorst, M. H.
Wig, Rudolph J.
Wilson, Edward F.
Wilson, Percy H.
Winchester Repeating Arms Company, Rupert L. Penney.
Wood and Company, R. D.,
Walter Wood.
Wood, Walter.
Woodroffe, G. H.

Young, J. Bertram.

Total number, 256; attendance, not including firms, etc., whose representatives also hold membership in their own name, 237.

## FIRST SESSION.—TUESDAY, JUNE 28, 3 P. M.

Vice-President Robert W. Lesley in the chair.

The minutes of the Twelfth Annual Meeting were approved as printed.

The annual report of the Executive Committee was accepted as printed. The Chair stated that the Regulations Governing Technical Committees, as given in Appendix II of the report, had been prepared by the Executive Committee after communicating with the chairmen of the various technical committees. The Chair also directed attention to the proposed modification of that paragraph in these regulations relating to the "Permanent Organization" of committees, referred to in the body of the report.

Mr. W. A. Bostwick moved that that paragraph be approved in the original form in which it appears in Appendix II. Mr. Walter Wood moved an amendment to this motion, that the question be referred to letter ballot of the Society. Mr. Edgar Marburg proposed the further amendment that the Executive Committee, in submitting this question to letter ballot of the Society, be instructed to have the notice to members accompanied by arguments pro and con prepared by the Executive Committee.

Mr. Bostwick accepted these proposed amendments with the understanding that the sense of the meeting on this question shall also be ascertained by vote and that the result of this vote shall be announced in connection with the notice for the letter ballot. The sense of the meeting was found to be favorable to Mr. Bostwick's original motion by an affirmative vote of 40 against a negative vote of 17. The original motion with the amendments above stated was then carried.

The amendments of the by-laws proposed by the Executive Committee and embodied in the annual report of that committee were then referred to letter ballot by a two-thirds vote of those present, as prescribed by the by-laws.

The Chair appointed Mr. Jesse J. Shuman and Mr. L. S. Moisseiff as tellers to canvass the ballot for officers and members of the Executive Committee.

The annual report of Committee A-3, on Standard Specifications for Cast Iron and Finished Castings, was presented by Mr. Walter Wood, Chairman.

In the absence of the authors the following papers were read by title:

"Tests of Cast-Iron Arbitration Test Bars." C. D. Mathews.

"Some Recent Tests of Cast Iron." A. E. Outerbridge, Jr.

"Unevenly Chilled and Untrue Car Wheels." T. D. West.

"The Forest Products Laboratory: Its Purpose and Work." McGarvey Cline.

On behalf of Committee E-1, on Standard Methods of Testing, Mr. Gaetano Lanza, Chairman, recommended that the proposed Standard Methods of Testing, presented by that committee at the last annual meeting and printed in Volume IX of the Proceedings, be submitted to letter ballot of the Society. This motion was carried by the requisite two-thirds vote.

Mr. J. A. Capp, Chairman of Committee B-1, on Standard Specifications for Hard-Drawn Copper Wire, presented a brief report of progress on behalf of that committee.

Mr. R. K. Johnson, as representative of Mr. H. V. Wille, Chairman of Committee A-10, on Standard Specifications for Staybolt Iron, recommended on behalf of that committee the adoption of the proposed Standard Specifications for Staybolt Iron, embodied in the report of the committee. That recommendation was approved by the prescribed two-thirds vote.

Mr. Henry Souther, Chairman of Committee A-7, on the Tempering and Testing of Steel Springs and Standard Specifications for Spring Steel, then presented an informal report on behalf of that committee.

The tellers reported that 225 ballots had been cast, and in accordance with their report the Chair declared the election of Mr. Henry M. Howe, President; Mr. Robert W. Lesley, Vice-President; Mr. Edgar Marburg, Secretary-Treasurer; and Mr. James Christie, member of the Executive Committee.

The meeting then adjourned till 8 P. M.

## SECOND SESSION.—TUESDAY, JUNE 28, 8 P. M.

President Henry M. Howe, on assuming the chair, expressed his hearty appreciation of the honor conferred upon him through his election to the presidency, and pledged himself to do all in his power to meet the responsibilities of the office.

The following papers were presented and discussed:

"The Welding of Blowholes in Steel." Henry M. Howe.

"Copper-Clad Steel: Its Metallurgy, Properties and Uses." Wirt Tassin.

"Tests Steel and Wrought-Iron Beams." H. F. Moore.

"Strength of Steel from I-Beams." E. L. Hancock.

The meeting then adjourned till the following morning.

## THIRD SESSION.—WEDNESDAY, JUNE 29, 10 A. M.

### *On Steel.*

President Henry M. Howe in the chair.

The annual report of Committee A-1, on Standard Specifications for Steel, Mr. W. R. Webster, Chairman, was read by title.

The following papers were then presented and discussed:

"Low-Carbon Streaks in Open-Hearth Rails." Max H. Wickhorst.

"The Influence of Titanium on Segregation in Bessemer-Rail Steel." G. B. Waterhouse.

"Cupro-Nickel Steel." G. H. Clamer.

On invitation of the Chairman, Mr. Robert W. Hunt occupied the chair for the remainder of the session.

A paper on a "Test of a Structural Steel Plate Partly Fused by Short-Circuited Electric Current," was read by Mr. A. W. Carpenter.

In the absence of the authors the following papers were read by title:

"Elongation and Ductility Tests in Rail Sections under the Manufacturers' Standard Drop-Testing Machine." P. H. Dudley.

"Further Notes on the Annealing of Steel." William Campbell.

The annual report of Committee A-8, on Standard Specifications for Cold-Drawn Steel, was presented by the Chairman, Mr. C. E. Skinner, and discussed.

The meeting then adjourned till 8 P. M.

## MEMORIAL SESSION.—WEDNESDAY, JUNE 29, 8 P. M.

President Henry M. Howe in the chair.

This Session was held in honor of the memory of Dr. Charles B. Dudley, late President of the International Association for Testing Materials and of the American Society for Testing Materials. The proceedings of this session are summarized in Volume X, and will appear in *extenso* in a special Memorial Volume.

## FIFTH SESSION.—THURSDAY, JUNE 30, 10 A. M.

### *On Cement and Concrete.*

Vice-President Robert W. Lesley in the chair.

The following motion was introduced by Mr. Leonard Waldo and carried:

That a committee of three be appointed by the President to report at the next annual meeting of the Society on the proper use of the term "Modulus of Elasticity" (Young's Modulus) in engineering specifications and descriptions, including its use in describing non-ferrous metallic materials and their combinations.

Mr. R. L. Humphrey, Secretary of Committee C-1, on Standard Specifications for Cement, and Committee C-2, on Reinforced Concrete, presented progress reports on behalf of those committees.

The following papers were then read and discussed:

"Aluminates: Their Properties and Possibilities in Cement Manufacture." Henry S. Spackman.

"The Effect of Sodium Silicate Mixed with or Applied to Concrete." Albert Moyer.

"Comparative Tests of Lime Mortar, both in Tension and Compression: Hydrated Lime and Sand, Lump Lime and Sand, and Cement-Lime and Sand." E. W. Lazell.

In the absence of the author the paper on "Tests of Reinforced Concrete Columns Subjected to Repeated and Eccentric Loads," by Mr. Morton O. Withey, was read by title.

A paper on "The Distribution of Stress in Reinforced Concrete Beams, including a Comparative Study of Plain Concrete in Tension and Compression," was presented by Mr. A. T. Goldbeck.

A paper entitled "A Sand Specification and Its Specific Application" was then read by Mr. W. A. Aiken, and discussed.

An informal description of tests on modeled and concrete arches was then presented by Mr. W. R. Davis on behalf of himself and Mr. R. S. Greenman.

The meeting then adjourned till 3 P. M.

### SIXTH SESSION.—THURSDAY, JUNE 30, 3 P. M.

*On Preservative Coatings and Oils.*

President Henry M. Howe in the chair.

The annual report of Committee D-1, on Preservative Coatings for Structural Materials, was introduced by the Chairman, Mr. S. S. Voorhees, and the reports of several sub-committees were then read, viz:

Sub-Committee B, on Inspection of Havre de Grace Bridge: W. A. Aiken, Chairman.

Sub-Committee C, on Inspection of Wooden Panels at Atlantic City: Robert Job, Chairman.

Sub-Committee E, on Linseed Oil: G. W. Thompson, Chairman.

Sub-Committee I, on Specifications for Varnish: G. B. Heckel, Chairman.

The annual report of Committee A-5, on the Corrosion of Iron and Steel, was presented by the Chairman, Mr. Allerton S. Cushman.

This was followed by a joint discussion of the reports of these two committees.

A paper on "Another Solubility Test on Protective Coatings" was read by Mr. G. W. Thompson.

In the absence of the author the paper entitled "Vermilion Paint for Railway Signals: Results of an Investigation," by Mr. Robert Job, was read by title.

The following papers were then read and discussed:

"The Painting of Cement and Concrete Structures." Charles Macnichol.

"Classification of Fine Particles According to Size." G. W. Thompson.

The annual report of Committee D-2, on Standard Tests for Lubricants, was presented by the Chairman, Mr. A. H. Gill.

The annual report of Committee D-3, on Standard Methods of Analysis of Fats and Oils, was presented by Mr. C. N. Forrest, Chairman.

A paper on "Some Exposure Tests of Structural-Steel Coatings" was then presented by Mr. C. M. Chapman.

The meeting then adjourned till the following morning.

### SEVENTH SESSION.—FRIDAY, JULY 1, 10 A. M.

*On Testing Machines and Apparatus.*

President Henry M. Howe in the chair.

A paper on "The 600,000-lb. Hydraulic Testing Machine of the University of Wisconsin and Its Calibration," by Mr. H. F. Moore and Mr. M. O. Withey, was presented by Mr. Moore, and discussed.

A paper entitled "The Scleroscope," by Mr. A. F. Shore, was read by Mr. H. C. Berry. The reading of this paper was followed by a general discussion on "Tests of Metals for Hardness."

The following papers were then read:

"Some Testing-Laboratory Accessories." J. Madison Porter.

"Apparatus for Repeated Loads on Concrete Cylinders and a Typical Result." H. C. Berry.

"An Autographic Rubber-Testing Machine." T. Y. Olsen.

The following papers were read by title:

"Brinell Ball Test Applied to Wood." W. K. Hatt.

"The Structural Materials Testing Laboratories, United States Geological Survey: Progress during the Year Ending June 30, 1910." R. L. Humphrey.

A paper entitled "Apparatus for the Microscopical Examination of Metals," by Mr. Albert Sauveur, was read by Mr. H. M. Boylston.

The meeting then adjourned till 3 P. M.

## EIGHTH SESSION.—FRIDAY, JULY 1, 3 P. M.

President Henry M. Howe in the chair.

The Chair announced that the form of the motion adopted at the Fifth Session relative to the appointment of a committee to define the term "Modulus of Elasticity" was not in conformity with the long-established usage of the Society, and that the Chair would accordingly entertain a motion for a reconsideration of that action. Such a motion for reconsideration having been made and passed, the original motion was carried in the following amended form:

> That the Executive Committee be requested to consider the desirability of appointing a committee to report on the proper use of the term "Modulus of Elasticity" (Young's Modulus) in engineering specifications and descriptions, including its use in describing non-ferrous metallic materials and their combinations.

On invitation of the President, Mr. James Christie then assumed the chair.

A paper on "The Determination of Soluble Bitumen," by Mr. Prévost Hubbard and Mr. C. S. Reeve, was read by Mr. Hubbard and discussed.

The following papers were then presented by their authors and discussed:

"Improved Instruments for the Physical Testing of Bituminous Materials." Herbert Abraham.

"Necessary Reforms in Specifications for Petroleum Products." Albert Sommer.

"A New Machine for Testing Pitch." T. Y. Olsen.

The annual report of Committee D-8, on Waterproofing Materials, was presented by the Chairman, Mr. W. A. Aiken, and discussed.

A paper on "Fuel Investigations, United States Geological Survey: Progress During the Year Ending June 30, 1910," by Mr. J. A. Holmes, was read by title.

The meeting then adjourned till the following morning.

## NINTH SESSION.—SATURDAY, JULY 2, 10 A. M.

Mr. L. W. Page in the chair.

After calling the meeting to order, the Chair invited Mr. J. M.

Goodell to the chair and then presented the following annual reports on behalf of the committees under his chairmanship:

Committee C-3, on Standard Specifications for Paving and Building Brick.

Committee D-4, on Standard Tests for Road Materials.

The latter report contained the recommendation that the "Proposed Tests for Bituminous Compounds for Roads and Pavements, including Method of Sizing and Separating the Aggregate in Asphalt Paving Mixtures" be passed to letter ballot of the Society. Inasmuch as the report in question had not previously been submitted to letter ballot of the Committee, the Secretary was instructed by two-thirds vote to refer the above recommendation to letter ballot of the Society, provided the previous vote of the Committee by letter ballot should be unanimous.

The annual report of Committee C-4, on Standard Specifications and Tests for Clay and Cement Sewer Pipe, Mr. Rudolph Hering, Chairman, was presented by Mr. A. J. Provost, Jr., Vice-Chairman.

The annual report of Committee D-7, on Standard Specifications for the Grading of Structural Timber, was, in the absence of the Chairman, Mr. Hermann von Schrenk, presented by the Secretary. The recommendation of the Committee, that the proposed Standard Specifications for Yellow-Pine Bridge and Trestle Timbers, presented last year and printed in the Proceedings, should be referred to letter ballot of the Society for adoption, was approved by the requisite two-thirds vote.

A brief verbal report on behalf of Committee A-6, on the Magnetic Testing of Iron and Steel, was presented by Mr. J. A. Capp.

A paper on "A Comparison of Magnetic Permeameters" was presented by Mr. Charles W. Burrows.

In the absence of the authors the following papers were read by title:

"The Exponential Law of Endurance Tests." O. H. Basquin.

"Measured Strains in a Steam Boiler under Hydrostatic Tests." James E. Howard.

The Chairman then declared the meeting adjourned *sine die.*

## ANNUAL REPORT OF THE EXECUTIVE COMMITTEE.

Since the Twelfth Annual Meeting of the Society, the Executive Committee has held four regular meetings and one special meeting. An abstract of the minutes of these meetings is appended to this report.

During the past year the Society has sustained a signal and irreparable loss through the death of its honored and beloved President, Dr. Charles B. Dudley, which occurred on December 21, 1909. The following Minute prepared by Dr. Henry M. Howe has been adopted by the Executive Committee and will be presented for adoption by the Society:

Let us record at once our deep grief and our deeper gratitude, our grief indeed at the loss of a great leader and dear friend, but above all, our gratitude that we have had the privilege of being led.

Such measure of usefulness as our Society has had it owes in very large part to that leadership. Here was a most rare combination of qualities, the sterling, the intellectual, the human, the judicial, each on a high level, all combining to form a character, a personality, whose like we shall not look upon again.

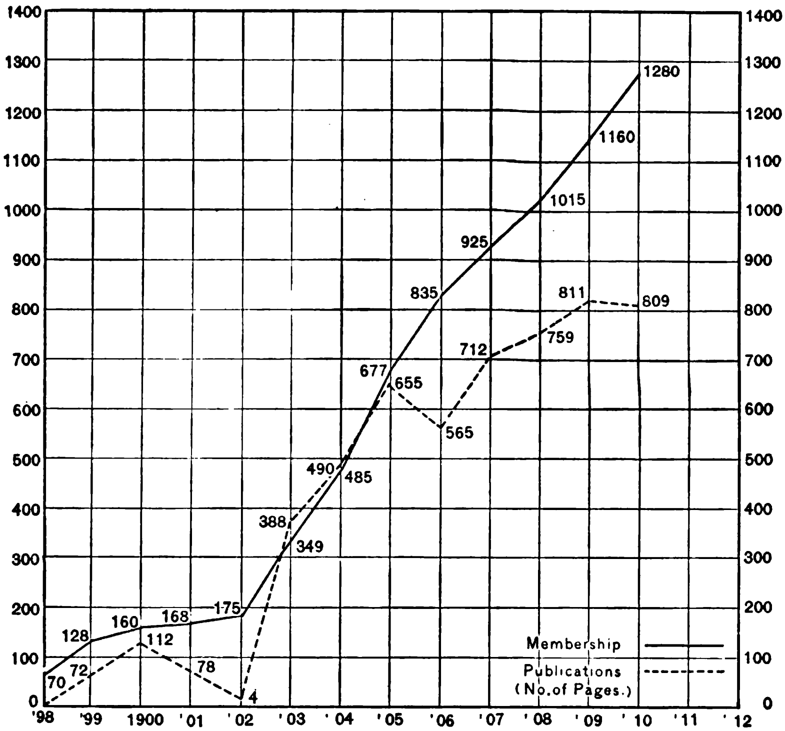
With a clear head to see the world's needs, to part the essential from the accidental and the merely concomitant, went the skillful and persuasive tongue to make clear to the rest of us what he had first made so clear to himself. With these went the perfect fearlessness, apparently even the unconsciousness of either danger or fear, which made him lead on where others would have flinched. With these again went his calm, clear, good judgment, which seemed to tell him spontaneously which among the good things that needed doing were the most worthy of being done, and what were the best and surest ways of doing them.

With all these admirable qualities went that which was necessary to the accomplishment of his high purposes, his kindness of heart, his sympathy and his tact, which made us all his allies in what he undertook. Had he a proposal? Our affection and veneration for him made us almost its advocates before it was unfolded. Its intrinsic wisdom, and the clearness with which he expressed it, found an audience ready, almost anxious, and certainly expecting to be convinced.

Great as were his tangible works, his greatest was the imponderable. Standing on a high platform, his call raised us towards his level, all the more effectively because of his complete unconsciousness of his own height. We who have known and loved him are for that knowledge and that love the better and the higher—how much, ah, who shall say?

As previously announced, a special Memorial Session in honor of the memory of Dr. Dudley will be held at the Thirteenth Annual Meeting of the Society, and arrangements will be made for the publication of a Memorial Volume worthily commemorative of his life and life-work.

*Membership.*—The membership at the last annual meeting was 1,160. Since then 154 applications for membership have been




approved. The Society has suffered the loss of 8 members through death: S. W. Baldwin, January 5, 1910; G. T. Barnsley, October 23, 1909; Chas. B. Dudley, December 21, 1909; Chas. S. Gowen, October 19, 1909; A. Hooper, December 28, 1909; Edmund Johnson, May 23, 1909; Wm. Metcalf, December 5, 1909; D. H. Pierce, July 1, 1909. The number of resignations for the year is 26, making the total loss by death and resignation 34, which leaves a net gain of 120 and a total membership at present

of 1,280. This estimate does not include members dropped by reason of delinquency in dues, the Executive Committee having decided to extend the time for delinquents till July 1, 1910.

*Publications.*—The publications of the year consist of Volume IX, containing 698 pages, and the yearly pamphlet of 139 pages. These publications aggregate 809 pages of printed matter exclusive of such parts as appear in duplicate. Seven official circulars of information were also issued during the year. The rapidly growing prestige of the Society is apparent in a striking and gratifying way from the large increase in the receipts for the past year from sales of publications, the total sum realized, as seen from the Treasurer's report, being $1,375.85 as compared with $875.44 for the year 1908–1909, representing an increase of nearly 60 per cent. for the year.

*Technical Committees.*—As previously announced, the large and constantly increasing number of technical committees has led the Executive Committee to authorize the adoption of a more systematic scheme of enumerating these committees, which became effective on May 1, 1910. By this scheme the technical committees are now designated by successive numerals affixed to letters representing the following classifications; A, Ferrous Metals; B, Non-Ferrous Metals; C, Cement and Clay Products; D, Miscellaneous Materials; E, Miscellaneous Subjects.

In pursuance, partly of action at the last annual meeting, and partly at its own initiative, the Executive Committee has authorized the creation of the following new technical committees:

A-2. On Standard Specifications for Wrought Iron.
A-9. On Alloy Steels.
A-11. On Metallurgical Research in Steel.
A-12. On Tests of Steel Structural Members.
B-2. On Non-Ferrous Metals and Alloys.
D-9. On Standard Tests of Insulating Materials.
D-10. On Standardizing Explosives.

The designation of Committee A-1 has been changed from that "On Standard Specifications for Iron and Steel" to that "On Standard Specifications for Steel."

Of the foregoing new committees, Committees A-2, A-11 and A-12 are in course of organization. The remaining four committees have been organized.

With the increasing number of technical committees, and the frequent inquiries as to the attitude such committees should assume in respect to numerous conditions of common occurrence, the Executive Committee thought it desirable to formulate certain general regulations for the guidance of such committees. The preliminary draft of the proposed regulations was submitted to the chairman of each technical committee and was amended by the Executive Committee in the light of criticisms and suggestions received. These regulations in their revised form were announced in Circular No. 46 to Members, and are added as Appendix II to this report. At a subsequent meeting of the Executive Committee it was decided that in submitting these regulations for consideration at the annual meeting, it be recommended that the paragraph relating to "Permanent Organization" be so amended that by three-fourths vote of the committee concerned a member of the committee representing manufacturing interests may be elected to the chairmanship. The proposed revised form of the paragraph in question is as follows:

*Permanent Organization.*—At the first meeting of a committee a permanent organization shall be effected by the election of a permanent chairman from among the representatives of consuming interests and unattached experts by majority vote of those present, or from among the representatives of manufacturing interests by three-fourths vote of those present; and by the election of such other officers, and the appointment of such sub-committees, as the committee may desire. The duties and powers assigned to these officers and sub-committees, and the details of management and administration in general, shall be at the discretion of each committee, subject to the limitations of these regulations.

*Finances.*—As foreshadowed in the last annual report, and as stated in Circular No. 47, issued in April, 1910, the Executive Committee after careful consideration has decided to recommend the amendment of the by-laws with a view of increasing the dues from $5.00 to $10.00 per annum, with the understanding that persons less than thirty years of age will be eligible for admission to a proposed new class of Junior Members, for whom the dues shall be $5.00 per annum.

The deficit at the end of the current fiscal year, estimated in the last annual report of the Executive Committee at over $3,000, is seen from the report of the Treasurer to amount actually to

nearly $2,200. The proposed increase of dues will enable the Society to cancel this deficit; to meet its running expenses promptly; to extend better financial support to its technical committees; to adopt a more liberal policy with respect to advance publications of papers and committee reports; to enlarge its clerical facilities; and to lease more adequate quarters for the storing and handling of its publications. As a more direct gain to every member of the Society, it is also proposed to issue a Year-Book bound in cloth which will be furnished annually to members, and which will contain, in addition to the contents of the present annual pamphlet, all standard specifications in revised up-to-date form. It is further proposed that the annual volume of the Proceedings shall hereafter be supplied to members in cloth binding without extra charge for binding, and that the additional charge for half-leather binding shall be reduced from $1.00 to 50 cents.

It is earnestly hoped that the proposed amendments of the by-laws, designed to effect this change, will receive the approval of the membership at large, since the issues involved are regarded as of vital importance to the well-being and future development of the Society. It is believed that the members share the feeling of the Executive Committee that the Society has given abundant proof that it deserves adequate financial support, not merely for its maintenance, but for its healthful growth.

## ANNUAL REPORT OF THE TREASURER.

From June 15, 1909, to June 15, 1910.

### RECEIPTS.

| | | |
|---|---|---|
| Membership dues | $3,164 91 | |
| Collections for account of International Association | 994 48 | |
| Sales of Publications | 1,375 85 | |
| Orders for binding | 184 50 | |
| Reprints | 249 62 | |
| Sales of right to reprint specifications for one year | 300 00 | |
| Temporary loan, Manayunk National Bank | 1,000 00 | |
| Interest on deposits | 21 43 | |
| Account of Committee D-1, credit balance | 215 00 | |
| Miscellaneous receipts | 49 27 | |
| Total receipts | $7,555 06 | |
| Cash balance, June 15, 1909 | 1,217 78 | |
| | | $8,772 84 |

DISBURSEMENTS.

| | | |
|---|---|---|
| Remitted to International Association | $675 45 | |
| For account of International Association, postage, printing, etc | 238 08 | |
| Printing, engraving, binding, etc | 2,750 95 | |
| Secretary's salary, May 31, 1909, to May 31, 1910 | 1,500 00 | |
| Clerical services | 1,609 35 | |
| Accountant's audits | 92 00 | |
| Expenses, Secretary's office | 443 65 | |
| Interest on temporary loan | 25 83 | |
| Rent, storage room | 171 60 | |
| Stenographer, Twelfth Annual Meeting | 168 00 | |
| Expenses, Twelfth Annual Meeting | 107 36 | |
| Expenses, Technical Committees | 25 32 | |
| Excess remittances refunded | 61 45 | |
| Miscellaneous disbursements | 7 50 | |
| Total disbursements | $7,876 54 | |
| Cash balance, June 15, 1910 | 896 30 | |
| | | $8,772 84 |

The reported receipts for membership dues, $3,164.91, are relatively small owing to the fact announced in the last annual report that the payment of dues for the fiscal year beginning July 1, 1909, had been anticipated to the extent of $3,385.00.

The financial condition of the Society is by no means as favorable as might be inferred from the above report of the Treasurer. Deducting the balance of $215.00 to the credit of Committee D-1, the net cash balance on June 15 is $681.30. The accounts collectible aggregate approximately $1,125.00, on which it is estimated that about $500.00 will be realized, which added to the net cash balance of $681.30 makes a total of $1,181.30. The outstanding liabilities are as follows:

| | |
|---|---|
| Loan on note | $1,000 00 |
| Due The John C. Winston Co., Publishers | 2,000 00 |
| Due International Association for Testing Materials | 185 00 |
| Miscellaneous accounts to June 15 | 175 00 |
| Total | $3,360 00 |

In the l'ght of the foregoing it is seen that instead of an apparent cash balance of $896.30, as stated in the Treasurer's report, there is an actual deficit of nearly $2,200.00.

*Proposed Enlargement of the Executive Committee.*—As announced in Circular No. 48, issued May, 1910, owing to the large

and rapidly increasing membership of the Society, and the varied interests represented in the same, as well as the desirability of recognizing different geographical districts, the Executive Committee has decided to recommend an amendment of the by-laws by which the membership of that committee will be increased from seven to eleven members.

*Proposed Amendments of the By-Laws.*—The proposed amendments looking to the enlargement of the Executive Committee are as follows:

ARTICLE II.

Strike out Sections 4 and 7, viz.,

SEC. 4. The Executive Committee shall consist of these officers and also the last Past President and three members, two being elected by letter ballot at each annual meeting in the odd years and one at each annual meeting in the even years.

SEC. 7. The officers and members of the Executive Committee of this Society to hold office until the next election under these by-laws, shall be as follows: To hold office for two years—President, Charles B. Dudley; Vice-President, Robert W. Lesley; Secretary-Treasurer, Edgar Marburg; Members of the Executive Committee, Henry M. Howe and James Christie. To hold office for one year—Members of the Executive Committee, Albert Ladd Colby and John McLeod.

Substitute the following new section:

SEC. 4. The Executive Committee shall consist of these officers and also the last Past President and seven members, four being elected by letter ballot at each annual meeting in the odd years and three at each annual meeting in the even years. Four members of the Executive Committee shall constitute a quorum.

Inasmuch as the necessities of the situation demand that the proposed increase of dues, previously referred to, shall become effective at once, and since the proposed amendments, if passed at the annual meeting and subsequently approved by letter ballot of the Society, cannot legally be made retroactive, the amendments are so worded that the fiscal year shall commence in 1910 on August 1, and that the dues from that date to December 31, 1910, shall be $5.00 for Members and $2.50 for Junior Members; the fiscal year thereafter beginning on January 1.

The proposed amendments are as follows:

ARTICLE I.

Strike out Sections 1 and 2, viz.,

SECTION 1. Any person, corporation or technical society can become a member of this Society upon being proposed by two members and being approved by the Executive Committee.

SEC. 2. Any member who subscribes annually the sum of fifty dollars ($50) towards the general funds of the Society shall be designated a contributing member, his rights and privileges as a member remaining unchanged. Contributing members shall be exempt from the regular membership dues.

Substitute the following new sections:

SECTION 1. The Society shall consist of Members and Junior Members.

SEC. 2. A Member shall be a person not less than thirty years of age, corporation, firm, technical society, teaching faculty or library, proposed by two members and approved by the Executive Committee.

SEC. 3. A Junior Member shall be a person less than thirty years of age on the date of his admission, proposed by two members and approved by the Executive Committee. A Junior Member shall have the same rights and privileges as a Member, and his status shall be changed from that of Junior Member to Member at the beginning of the fiscal year next succeeding the date on which he attains the age of thirty years.

Change the designation of existing Section 3 to Section 4.

ARTICLE V.

Strike out Sections 1, 2 and 6, viz.,

SECTION 1. The fiscal year shall commence on the first of July, and all dues shall be payable in advance.

SEC. 2. The annual dues of each member shall be $5.00. Members holding membership also in the International Association for Testing Materials shall pay annually the additional sum of $1.50, which shall be transmitted by the Secretary to the International Association.

SEC. 6. Charges for cloth and half-leather binding for the Proceedings shall be payable in advance.

Substitute the following new sections:

SECTION 1. The fiscal year shall commence in 1910 on the first of August and the dues from August 1, 1910, to December 31, 1910, shall be $5.00 for Members and $2.50 for Junior Members.

SEC. 2. The fiscal year after December 31, 1910, shall begin on the first of January and the annual dues from and after January 1, 1911, shall be $10.00 for Members and $5.00 for Junior Members, payable in advance.

SEC. 3. Members or Junior Members holding membership also in the International Association for Testing Materials shall pay annually, in advance, the additional sum of $2.00, the fiscal year of the International Association beginning on the first of January, which sum shall be transmitted by the Treasurer to the International Association.

SEC. 4. Any Member or Junior Member may compound his dues at the beginning of any fiscal year by the purchase of a life membership, exempting him for life from annual dues, by the payment of the sum of one hundred and fifty dollars ($150).

Change the designation of existing Sections 3, 4 and 5 to Sections 5, 6 and 7 respectively.

At a recent meeting of the Executive Committee it was decided to recommend that Section 4, Article V of the above amendments be further amended by adding the words "provided such membership is held by an individual. The cost of life membership, or membership in perpetuity, to corporations, firms, technical societies, teaching faculties or libraries shall be two hundred dollars ($200)."

*International Association for Testing Materials.*—The Fifth Congress of the International Association for Testing Materials, held in Copenhagen, September 7-11, 1909, was a notable occasion from every point of view. The attendance, which embraced official delegates from 22 governments, numbered about 900 persons, who had assembled from all parts of the civilized world. Of especial interest to the American members of the Association is the action by which it was decided to hold the Sixth Congress in the United States in 1912, and the election of the late Dr. Charles B. Dudley to the Presidency of the Association.

Following the first meeting of the Council of the International Association after the death of President Dudley, held February, 1910, the following letter of condolence was addressed to the American Society for Testing Materials, on behalf of the Council:

*Gentlemen:* We have the honor of informing you that the Council of the International Association for Testing Materials at their last meeting, February 5, passed the following Resolution:

The Council at their meeting in Frankfort a. M., give expression to their feelings of sorrow at the heavy loss suffered by the Association

through the death of their revered President, Dr. Charles B. Dudley, who was recently elected amid general enthusiasm.

The Council mourn in the deceased an indefatigable and successful researcher in the domain of Testing Materials, and at the same time a man of the finest heart and noblest nature.

In order to show some open token of veneration and to keep green the memory of Dr. Dudley as a researcher among the international circles of the Association's members, the Council have resolved to publish in their tri-lingual Proceedings a Memoir, which, besides a biographical sketch, will also contain a critical appreciation of Dr. Dudley's works and writings.

Believe us, gentlemen, to be

Yours faithfully,

In the name of the Council of the International Association for Testing Materials,

ERNST REITLER, *General Secretary.*

A. MARTENS, *First Vice-President.*

The Vice-President and General Secretary of the Association had previously, under date of December 28, 1909, announced the death of the President to the members of the Association in a special number of the Proceedings, in which fitting expression was given, on behalf of the Association, to their sense of loss at the death of the President.

At a meeting of the Council of the International Association, held on February 5, 1910, Dr. Henry M. Howe was unanimously elected to the Acting Presidency of the Association.

Progress of a practical nature towards the evolution of international specifications for the important materials of construction was made at the Congress on the basis of a report from Committee I on International Specifications for Iron and Steel, premised on the work of a sub-committee consisting of two members each from Germany, England, and the United States. This action is reported in detail by the American members of this sub-committee, Mr. W. R. Webster and Mr. Walter Wood, in their reports to their respective committees, the one on Standard Specifications for Steel and the other on Standard Specifications for Cast Iron and Finished Castings, so that further reference here to this subject is unnecessary.

The total membership in the International Association in April, 1910, was 2,463, Germany leading with 400 members and

the United States being second with 381 members. During the past year the American membership has increased from 305 to 415, or over one-third. Every effort will be made to increase this number largely before the Sixth Congress which, as previously stated, will be held in this country. Every member of the American Society is by virtue of such membership eligible for admission to the International Association. Application blanks for membership may be obtained from the Secretary of the American Society. The annual dues in the International Association were increased from $1.50 to $2.00 at the Copenhagen Congress. The fiscal year begins on January 1 and there is no initiation fee. Members of the Association may obtain the Proceedings of the Copenhagen Congress, aggregating over 1,000 pages of printed matter, in German, French, or English. The English edition is almost exhausted, but the remaining sets will be supplied by the Secretary of the American Society at the nominal price of $2.00.

It is earnestly hoped that the American members of the International Association will actively support the Executive Committee in its cooperation with the Council towards the success of the Sixth Congress, and at this time especially in increasing the membership in this country.

Respectfully submitted on behalf of the Executive Committee,

ROBERT W. LESLEY,
*Vice-President.*

EDGAR MARBURG,
*Secretary-Treasurer.*

# APPENDIX I.

## ABSTRACT OF MINUTES OF THE EXECUTIVE COMMITTEE.

REGULAR MEETING, June 30, 1909.—Hotel Traymore, Atlantic City, N. J. Present: Mr. C. B. Dudley, President; Mr. R. W. Lesley, Vice-President; Mr. James Christie, Member of the Executive Committee; and Mr. Edgar Marburg, Secretary-Treasurer.

The Secretary reported the receipt of 54 applications for membership, duly approved, and the dropping of 41 members, making the total membership on June 15, 1909, 1,160.

The President agreed to the suggestion that he represent the American Society at the Copenhagen Congress of the International Association for Testing Materials. The Secretary was authorized to make additional appointments on behalf of the Executive Committee from among the American members expecting to attend the Congress.

The creation of the following new committees was authorized: (*a*) On Alloy Steels, (*b*) On Non-Ferrous Metals and Alloys, (*c*) On Explosives, (*d*) On Standard Samples, and (*e*) On Standard Specifications for Wrought Iron.

The appointment of an independent committee on Wrought Iron was made at the recommendation of Committee A. The further recommendation of that Committee, that it shall be designated hereafter as the Committee "On Standard Specifications for Steel," was approved.

The Secretary called attention to the following resolution adopted at the last annual meeting: "That the Executive Committee be instructed to consider the desirability of increasing the testing facilities of the country by the construction of a testing machine of sufficient capacity for the testing of large full-size members and to recommend to the Society such action as in their judgment might seem best." It was decided to introduce a suitable resolution of a favorable nature at the current annual meeting, with a view of having the same referred to letter ballot of the Society.

The Secretary was instructed to notify the chairmen of the various technical committees, that any funds collected for the uses of such committees shall hereafter be remitted to the Secretary-Treasurer to be disbursed by him only on the basis of itemized vouchers approved by the chairman of the committee concerned.

REGULAR MEETING, October 25, 1909.—Engineers' Club, Philadelphia, Pa. Present: Mr. C. B. Dudley, President; Mr. R. W. Lesley, Vice-President; Mr. W. A. Bostwick, Mr. James Christie and Mr. W. R. Webster, Members of the Executive Committee; and Mr. Edgar Marburg, Secretary-Treasurer.

The Secretary reported that 10 new members had qualified for membership, that 4 members had resigned, and that there had been a loss of 1 member by death, namely, Chas. S. Gowen, who died on October 19, 1909, making the total membership on October 25, 1909, 1,165.

The urgent need of devising means of effecting a substantial increase in the revenues of the Society was recognized in the light of a report on the part of the Secretary-Treasurer of a probable deficit of $2,300 at the end of the fiscal year. After considerable discussion it was decided to recommend at the next annual meeting that the by-laws be amended with a view of increasing the dues from $5.00 to $10.00 with the understanding

(*a*) That a Year-Book, bound in cloth, shall be furnished annually to members, containing in addition to the contents of the present annual pamphlet, all standard specifications in revised up-to-date form. There are at present twenty-four standard specifications aggregating 121 pages, which, with the other matter referred to, will make a volume next year of about 275 pages.

(*b*) That the annual volume of the Proceedings shall hereafter be supplied in cloth binding to members without extra charge for binding. and that the additional charge for half-leather binding shall be 50 cents instead of $1.00.

The Secretary called attention to the fact that the proposed increase of dues will enable the Society not only to cancel the estimated deficit of $2,300 at the end of the current fiscal year, but that it would then also be possible to meet the running expenses promptly; to extend better financial support to technical committees; to adopt a more liberal policy with respect to advance publications of papers and committee reports; to enlarge the clerical facilities; and to lease more adequate quarters for the storing and handling of publications.

The Secretary was authorized to negotiate a temporary loan of $1,000.

The Secretary was instructed to submit at the next quarterly meeting a proposed new scheme of enumerating the standing technical committees.

The Secretary was further instructed to prepare a set of proposed regulations governing technical committees, with a view of submitting the same for criticism and suggestions to the chairmen of the various technical committees, and presenting a report at the next meeting of the Executive Committee.

President Dudley presented an informal report of the proceedings of the International Congress, held at Copenhagen, September 7–11, 1909.

REGULAR MEETING, January 17, 1910.—Engineers' Club, Philadelphia, Pa. Present: Mr. R. W. Lesley, Vice-President; Mr. W. A. Bostwick, Mr. James Christie and Mr. W. R. Webster, Members of the Executive Committee; Mr. Edgar Marburg, Secretary-Treasurer; and Mr Walter Wood, on invitation as one of the two American representatives on Sub-Committee Ia on International Specifications.

Two communications, under date of December 15, 1909, addressed by Dr. A. Rieppel, Chairman of Committee I, to the members of Sub-Committee Ia, were presented. The Secretary was instructed to request, on behalf of the Executive Committee, an official interpretation on the part of the International Council of the resolutions passed at the Copenhagen Congress whereby certain specifications are to be stamped, if so desired, as follows: "Recommended by the International Association for Testing Materials for use for material manufactured in (name of country concerned) on export orders."

Mr. Wood then withdrew and the business of the meeting proceeded as follows:

The Secretary reported the receipt of 64 applications for membership, duly approved, the resignation of 12 members, and the loss by death of 2 members, namely, President Chas. B. Dudley, December 21, 1909, and Wm. Metcalf, December 5, 1909, making the total membership on January 1, 1910, 1,215.

The Secretary presented a report from John Heins & Co., Public Accountants and Auditors, dated January 15, 1910, to the effect that they had made "an audit and examination of the books and accounts of the Society for the six months ending December 31, 1909, and report them to be correct and carefully kept."

The Secretary presented letters of condolence from the Secretary of the International Association for Testing Materials to the Vice-President and Secretary of the Society on the death of President Dudley, as well as a copy of Proceedings No. 14 of the International Association, containing the announcement of the death of the President of the Association, and appropriate expressions of sorrow, signed by the First Vice-President and the Secretary of the Association. He also presented a letter of sympathy from Mr. Leslie S. Robertson, Secretary of the British Engineering Standards Committee.

It was decided to entrust the preparation of resolutions on behalf of the Executive Committee on the death of President Dudley to Mr. Henry M. Howe, Past President of the Society, with the understanding that these resolutions are to be announced in an early circular to members, and that they are to be presented for adoption by the Society at a special memorial session commemorative of Dr. Dudley, to be held in connection with the next annual meeting.

It was further decided to invite eminent men to speak at this memorial session of the many-sided activities of Dr. Dudley as a scientist, citizen, and man; also that the Society shall assume the publication of a memorial volume devoted to the life and life-work of Dr. Dudley.

The following members of the International Association for Testing Materials were appointed as a Committee on Nominations to fill the vacancy in the Council of the International Association occasioned by the death of Dr. Dudley: Mr. R. W. Lesley, Mr. W. A. Bostwick, Mr. W. R. Webster and Mr. Edgar Marburg. That Committee reported

unanimously the choice of Mr. Henry M. Howe as a candidate for the office of American representative on the International Council.

The Secretary was instructed to announce this nomination in an early circular to the American members of the International Association, and to state in that circular that every member may exercise his individual right to cast his vote as he may desire.

In order that the proposed amendments to the by-laws looking to an increase of dues be made effective with the beginning of the next fiscal year, July 1, 1910, the Secretary was instructed to frame these proposed amendments in such a way as to change the date of the beginning of the new fiscal year to August 1, 1910, with a view of rendering bills for $5.00 bearing that date for dues up to December 31, 1910, and to indicate that following that date the fiscal year will begin on January 1, and that bills for $10.00, covering dues for the fiscal year 1911, will be issued on January 1, 1911.

The question of recommending the creation of a new class of Junior Members, with dues at the rate of $5.00 per annum, was discussed, but final action was deferred pending a circular inquiry on the part of the Secretary to ascertain approximately the present number of members below thirty years of age.

The Secretary reported a proposed agreement with the Engineering News Book Department relative to the advertising and sale of the standard specifications, which was on motion approved.

It was decided to authorize the creation of the following additional committees: (*a*) On Metallurgical Research in Steel, (*b*) On Tests of Steel Structural Members.

The Secretary submitted the proposed "Regulations Governing Technical Committees", prepared in pursuance of instructions at the last meeting of the Executive Committee, and sent in printed form to the chairmen of all standing technical committees for criticism and suggestions. These regulations were reviewed in their proposed amended form in pursuance of suggestions from several chairmen of technical committees and adopted.

The creation of a Committee on Standard Samples, on which favorable action had been taken at a previous meeting, was reconsidered, and in the light of a communication from the Director of the United States Bureau of Standards it was decided that this matter shall be left for the present to the appropriate existing technical committees.

REGULAR MEETING, April 4, 1910.—Engineers' Club, Philadelphia, Pa. Present: Mr. R. W. Lesley, Vice-President; Mr. James Christie and Mr. Henry M. Howe, Members of the Executive Committee; and Mr. Edgar Marburg, Secretary-Treasurer.

The Secretary reported the receipt of 58 applications for membership, duly approved, the resignation of 1 member, and the loss by death of 4 members, namely: S. W. Baldwin, January 5, 1910; G. T. Barnsley,

October 23, 1909; A. Hooper, December 28, 1909; and Edmund Johnson, May 23, 1909.

The Secretary reported that the letter ballot on the nomination of Mr. Henry M. Howe as the American representative on the Council of the International Association had resulted favorably, and also that the Council of the International Association had on February 5, 1910, elected Mr. Howe as Acting President of the International Association for Testing Materials.

The Secretary reported that the statistical inquiry regarding the number of members below thirty years of age had resulted in returns from 67 members with ages ranging from 24 to 29 years, the average age being somewhat above 27 years.

It was decided to recommend the creation of a new class of Junior Members limited to persons less than thirty years of age, with dues at $5.00 per annum.

The Secretary submitted a proposed scheme of enumerating the technical committees by successive numerals affixed to letters designating the following classifications: A, Ferrous Metals; B, Non-Ferrous Metals; C, Cement and Clay Products; D, Miscellaneous Materials; E, Miscellaneous Subjects. This recommendation was on motion approved.

SPECIAL MEETING, May 16, 1910.—Engineers' Club, Philadelphia, Pa. Present: Mr. R. W. Lesley, Vice-President; Mr. James Christie, Mr. Henry M. Howe and Mr. W. R. Webster, Members of the Executive Committee; Mr. Edgar Marburg, Secretary-Treasurer; and Mr. Walter Wood, on invitation.

The Secretary submitted a letter under date of April 20, from the Secretary of the International Association, in reply to the inquiry relative to the stamping of international specifications, which he had addressed to the International Association in pursuance of action at the meeting held on January 17, 1910. Briefly stated, the Council had appointed a sub-committee of three members on this subject by whom no action had as yet been taken. It was decided that since the matter is one strictly within the province of the International Association, the Executive Committee should not commit itself to any formal expression of opinion as to the policy to be pursued in this matter till the next International Congress.

It was agreed, however, to instruct Mr. Henry M. Howe, Acting President of the International Association, as American representative on the Council, to state at the next meeting of the Council, that in the judgment of the Executive Committee, it was desirable that at the next Congress the authorization for stamping specifications should preferably take the form of a certificate that the specifications in question represent standard specifications for material manufactured in a given country, and that the following form be recommended for that purpose: "Certified by the International Association for Testing Materials as Standard

Specifications for (designation of material) manufactured in (name of country)."

The provision in the "Regulations Governing Technical Committees," by which the chairmanship of a committee dealing with subjects having a commercial bearing is to be held by a representative of the consuming interests or an unattached expert, was then considered, and it was decided that in submitting these regulations for consideration at the approaching annual meeting, it be recommended that a representative of the manufacturing interests will be eligible to such chairmanship by three-fourths vote of such committee.

It was decided to submit amendments to the by-laws at the next annual meeting looking to an increase of the membership of the Executive Committee from seven to eleven members, with the provision that a quorum shall consist of four members.

On the withdrawal of Mr. Wood the business of the meeting proceeded as follows:

It was decided to recommend at the approaching annual meeting that the proposed amendments of the by-laws by which the cost of life membership is fixed at $150, be so changed that this sum shall apply only to membership held by individuals and that the cost of membership in perpetuity to corporations shall be $200.

The Secretary reported that Mr. Richard Moldenke desired to be relieved from the chairmanship of the Advisory Committee on Cast Iron, but that he would be willing to retain membership on that Committee. It was agreed to invite Mr. Henry Souther to accept the chairmanship of that Committee.

The appointment of Mr. Anderson Polk to the chairmanship of the Entertainment Committee at the approaching annual meeting was approved with the understanding that he be authorized to appoint other members on this committee.

# APPENDIX II.

## REGULATIONS GOVERNING TECHNICAL COMMITTEES.

*Creation.*—The creation of a technical committee shall be subject to the authorization of the Executive Committee, acting either on a recommendation adopted by majority vote at an annual meeting of the Society, or on its own initiative.

*Appointments.*—Appointments on technical committees shall be made by the Executive Committee subject to the following provisions:

1. On committees dealing with subjects having a commercial bearing, either an equal numeric balance shall be maintained between the representatives of consuming and producing interests; or the former may be allowed to predominate with the acquiescence of the latter. Unattached experts shall be classed with the representatives of consuming interests.
2. Additional appointments on existing committees shall be made only on the recommendation of, or with the approval of, such committees.
3. Only members of the Society shall be eligible, in general, to appointment on committees, although exceptions may be authorized by the Executive Committee in favor of representatives of government branches or other societies.

*Preliminary Organization.*—The President of the Society will appoint the chairman *pro tem.* of a new committee from the representatives of the consuming interests and unattached experts. The chairman *pro tem.*, after communicating with the other members of the committee, will fix the place and time of the first meeting. He may, at his discretion, appoint one or more members of the committee to prepare matter in advance for consideration at that meeting or he may prepare such matter himself. This procedure is recommended as calculated to economize time at the meeting and to afford a definite basis for discussion.

*Permanent Organization.*—At the first meeting of a committee a permanent organization shall be effected by the election of a permanent chairman from among the representatives of consuming interests and unattached experts, and such other officers and sub-committees as the committee may desire. The duties and powers assigned to these officers and sub-committees, and the details of management and administration in general, shall be at the discretion of each committee, subject to the limitations of these regulations.

*Reports.*—The reports of technical committees shall be presented at the annual meetings. Reports embodying any features on which specific

action on the part of the Society is recommended by the committee, must first have been submitted to letter ballot of the committee, and such features must have received the approval of the majority of those voting. Dissenting members shall have the right to present minority reports individually or jointly.

*Specifications.*—Proposed new and standard specifications or the proposed amendment of existing specifications must originate in the particular committee within whose province such specifications properly belong. No action affecting specifications shall be taken by any technical committee except at meetings called for that purpose. Action at such meetings shall be subject to majority vote of those voting, and subsequently to majority vote of those voting on letter ballot of the entire committee. Dissenting members shall have the right to present minority reports, individually or jointly, at the annual meeting of the Society at which the majority report is presented.

Any recommendations affecting specifications presented by the appropriate committees at the annual meetings of the Society may be amended by a majority vote of those voting, and the final adoption of new or amended specifications shall be subject to the following procedure:

1. Approval at an annual meeting by two-thirds vote of those voting.
2. Approval by letter ballot of the Society by two-thirds vote of those voting.

*Cooperation with Other Committees.*—A committee may, at its discretion, invite the cooperation of committees of other societies on like or cognate subjects, provided such relations shall entail no obligations at variance with these regulations, and shall impose no restrictions upon the free and independent action of the committee.

A committee desiring to bring about the appointment of similar committees by other societies for purposes of cooperation, shall address a recommendation to that effect to the Executive Committee and, on the approval of the latter, negotiations to the desired end shall be conducted on behalf of the Executive Committee by the Secretary of the Society.

*Publications.*—Committees shall have no right to issue matter for publication through other than the regular Society channels, unless so authorized, for exceptional reasons, by the Executive Committee.

*Current Expenses.*—The current expenses of committees for stationery and postage will be assumed by the Society. Stationery of standard form will be furnished by the Secretary of the Society on application of the chairman or secretary of a committee. Expenses for postage will be paid by the Treasurer of the Society on vouchers approved by the chairman of a committee.

*Extraordinary Expenses.*—Expenses for items other than stationery and postage will not be assumed by the Society, unless such expenditures were incurred in pursuance of authorization of the Executive Committee,

on recommendation of the chairman of the committee concerned, and within amounts specially fixed by the Executive Committee.

*Special Funds.*—Committees engaged on subjects having a commercial bearing shall be authorized to solicit contributions from manufacturers towards research funds. Contributions from consumers to funds for this and other purposes shall be solicited only by the Executive Committee. All funds thus collected shall be transmitted to the Treasurer of the Society and deposited by him in bank and placed to the credit of the committees on the books of the Society, subject to disbursement only on vouchers signed by the chairman of the committee concerned.

*Salaries and Fees.*—Committees shall not be authorized to pay salaries or professional fees in any form to any of their officers or members. Assistants in connection with research work may be engaged at salaries or special compensation fixed by the committees concerned, provided that funds for such salaries or compensations shall previously have been deposited with the Treasurer of the Society. Payments for such purposes shall be made by the Treasurer of the Society only on vouchers approved by the chairman of the committee concerned.

*Discharge of Committees.*—Technical committees may be discharged by the Executive Committee, either at their own request or with their consent, on the completion of the work for which they were appointed or in consequence of protracted inactivity.

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*Bulletin No.* 5. Preliminary Report on the Present State of Knowledge Concerning Impact Tests, by Professors W. Kendrick Hatt and Edgar Marburg. October, 1899. Pp. 27–52.

*Bulletin No.* 6. Report of Second Annual Meeting, August 15–16, 1899. Minutes of the Executive Committee to August 16, 1899. November 1899. Pp. 53–72.

*Bulletin No.* 7. Minutes of the Executive Committee to January 6, 1900. Miscellaneous Announcements. January, 1900. Pp. 73–80.

*Bulletin No.* 8. Proposed Standard Specifications for Structural Steel for Bridges and Ships. May, 1900. Pp. 81–86.

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